AN INVESTIGATION OF THE EFFECT PLATE EXPOSURE HAS ON DOT CHANGE, COMPARING A NEW DRY PROCESS SILVERLESS FILM WITH CONVENTIONAL SILVER FILM

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Abstract

The dot change effects that are associated with a new non-silver dry-processed graphic arts film are described. The new film is compared to traditional silver film for platemaking and on press for two different press runs. The objective of this preliminary research was to see what effect varying plate exposures will have on the new film comparative to traditional silver film. This paper discusses the imaging process, the platemaking characteristics and the information gained from both the conventional lithographic press run and the waterless lithographic press run.

Introduction

Dot change is the change in the size of the halftone dot from one medium to another. This occurs when one goes from film to proofs, from film to plates, or from plates to press sheet. Dot change is an inherent part of printing; by the nature of the printing process dot change will happen. Therefore, trying to eliminate it is futile; however if the dot change is known, it can be accurately controlled throughout the printing process. When dealing with color printing, dot change will have an effect on the printed color hues; an object's color can look different than what was anticipated. This can have a great perceived effect on memory colors such as flesh tones, blue skies, or green grass; observers will notice these hue shifts immediately.

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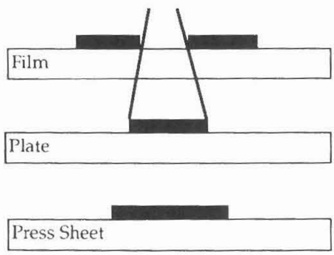
When using negative working plates it is a common practice to somewhat over expose the plate. This is done in order to harden the coating to improve run length. Longer running plates allow for more efficient printing with less plate changes. However the major drawback to this is that as the exposure is increased the light scattering effects are increased which will in turn increase the size of the dot areas on the plate. This is represented in Figure 1.

Figure 1

Light Scattering for a Negative Plate



For this preliminary research, VSX film was used to compare against traditional silver halide graphic arts film. VSX is a non-silver electrophotographic film which is dry-processed. It is a film that is used to make color separations for printing. The film is based on particle migration imaging technologies[1-4] which uses heat to process the images. VSX is a positive working material which is sensitive to the blue-green region of the electromagnetic spectrum, the film has an overall reddish tint to it.

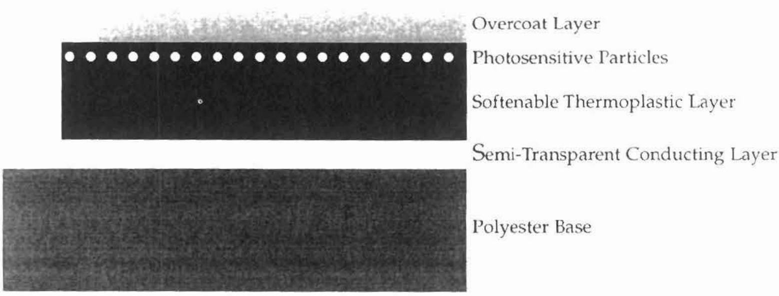
Imaging Process Steps

Film Structure

The general structure of the VSX film is shown below in Figure 2

Figure 2

VSX Film Structure



The VSX film is comprised of four layers. The bottom layer is a polyester base which is aluminized to 50% optical transmission. On top of this is coated the thermoplastic matrix polymer layer. This is where the monolayer of Selenium particles is located. An overcoat is then applied to help protect the film from abrasion.

Imaging Process Steps

The VSX film is sensitive to the blue-green region of the spectrum, therefore it is imaged in a scanner or imagesetter that is equipped with an argon ion light source, this would be typically 488 nanometers. At the time of this research scanners and imagesetters were in the process of being modified for use with the VSX film. This meant the VSX had to be imaged not in a self contained unit but in separate parts,with a light source that would simulate an argon ion light source. Therefore the VSX film was contact exposed on a vacuum frame with a 490nm filter over the exposing head of the lamp. The imaging process consisted of three main steps: charging, exposing, and processing.

The film is given a uniform negative charge on top of the emulsion which results in the base being given a positive charge. This charging now makes the film light sensitive. When the VSX is exposed to light the negative charge gets transferred to the exposed selenium particles. Heat is applied to process the image, this softens the thermoplastic that the selenium layer is in. Causing the particles that were exposed by the light and now have a negative charge to migrate towards the base of the film which has a positive charge, thus creating the Dmin area.

The charging was done on a charging table that was made up of a ground plate with a corotron charging unit. The corotron unit charged the film which was was laid emulsion up. This is the reason that the VSX base needs to be aluminized, so it can conduct electricity and hold the charge.

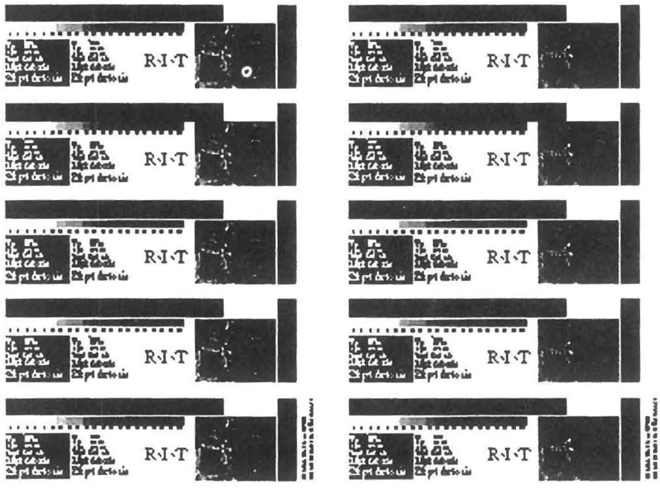
After the film was charged it became light sensitive. It was put in the vacuum frame with a silver halide (AgX) film negative over it, emulsion to emulsion. The AgX negative was produced on an Agfa Selectset 5000 imagesetter at 2400 dpi with a 133 line screen ruling, from a digital file. The VSX is a positive working system therefore the resulting image was a negative VSX film of the test form. From earlier testing it was found that a good contacting exposure for the VSX was 20 seconds with a 490nm filter in front of the light source 38.5 inches above the frame. The charging, exposing and processing of the VSX were all done under red safelight conditions.

The final step in the imaging process was the processing of the VSX film. This was done with heat rollers. The film was passed over the rollers which were revolving at a controlled speed. Previous research showed that a good processing speed and temperature was .60 in/sec at 120° C for each of the rollers. This process produced the four color separations of the test form.

Test Form

The test form that was used in this research was created digitally on a Macintosh Quadra 700, it is shown in Figure 3 below.

Figure 3
Test Form



It consisted of five identical areas that had percent dot patches, type, a color image and a UGRA control wedge which was contacted to the film during the imaging stage. Therefore the full UGRA wedge that is seen on the press sheet is not original to the plate. However the smaller continuous tone and microline section is original to the plate and was used to control plate exposure. The area was duplicated five times so that there would be a way to compare the five different plate exposures. This negative was produced on AgX film from an imagesetter. It was then contact exposed to the VSX and processed. To keep the experiment consistent, the AgX film was then contact exposed onto positive duping film. This way there was a half of the test form that was contact exposed onto VSX film and a half of the test form that was contact exposed onto AgX film. These two films were assembled next to each other and used to burn the two types of printing plates.

Platemaking and Printing Characteristics

This experiment involved both the waterless and conventional lithographic printing process. Both printing runs were done in the School for Printing Management and Sciences at the Rochester Institute of Technology in Rochester, New York They were both run on a Heidelberg 72V four color press. This press has been retrofitted with a cooling system to facilitate waterless printing.

Conventional Lithography

For the conventional lithography press run 3M Viking GMX plates were used. Test exposures were done with the VSX film and the GMX plate in order to yield the target exposure for that film plate combination. By looking at the microline targets and the continuous tone wedge it was found that 560 exposure units yielded the target exposure for the system. For the AgX film it was found that 100 exposure units was the target exposure. A healthy microline of 10µ was considered target exposure. Once the target exposure was obtained the other four exposures were mathematically calculated, using one step equivalents on the sensitivity guide. Therefore the target exposure was multiplied by 1.41 to get one step over and divided by 1.41 to get one step under and so on. This yielded the exposures listed below.

AgX	Se
194	1120
141	792
100	560
71	396
50	280

Each area of the test form was individually exposed while the rest of the plate was masked out, therefore each plate in actuality received ten different exposures.

Waterless Lithography

For the waterless lithography press run Toray plates were used. After testing it was found that 560 exposure units yielded that the target exposure for the system. For the AgX film it was found that 80 exposure units was the target exposure. Again the other exposures were mathematically calculated by using a factor of 1.4. This yielded exposures listed below.

AgX	Se
160	1120
113	792
80	560
57	396
40	280

The exposure times show that because of the higher Dmin the VSX requires a longer exposure time, typically about 5 times as much.

Dot Change Analysis

The dot area patches were measured for all the exposures on both press sheets. This yielded the dot change values for the VSX and the AgX test areas. These dot change numbers are shown in tables 1 – 4 and charts 1 – 10. The charts show the dot change curves for each exposure (Exposure 1 being two steps under exposed, Exposure 3 being the target exposure and Exposure 5 being two steps over exposed) with the VSX and the AgX plotted together on each chart.

Conventional Lithography

These charts are showing that for the same relative exposure there was not much of a difference between the dot change experienced in the VSX film and the dot change experienced in the AgX film, for the conventional process. The small dot change effects that are seen in the charts can be attributed to the experimental noise in the system. The AgX film generally seemed to show more dot change, mainly in the highlights than the VSX film did. In the shadow areas the two films were extremely similar. However on the fifth exposure the dot change for the VSX was greater than the dot change for the AgX. Perhaps this trend would continue to rise as the exposure rose.

Waterless Lithography

The waterless process showed an overall higher dot change for both films. The difference between the VSX and the AgX films is more pronounced. The AgX film generally seems to show more dot change, mainly in the highlights than the VSX film does. In the shadow ares the two films are extremely similar.

Conclusion

The effect that change in exposure has on the change in the printed dot size has been discussed. The experiment that was used to examine this has been described. The VSX has shown to exhibit very similar dot change characteristics to that of AgX films and in some cases lower when used in both conventional and waterless lithography. This film has shown that it can be used in the printing process with very good results.

Acknowledgements

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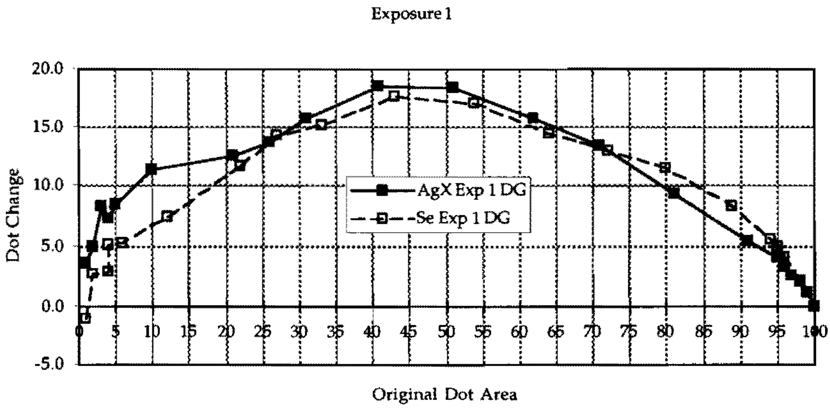

Chart 1

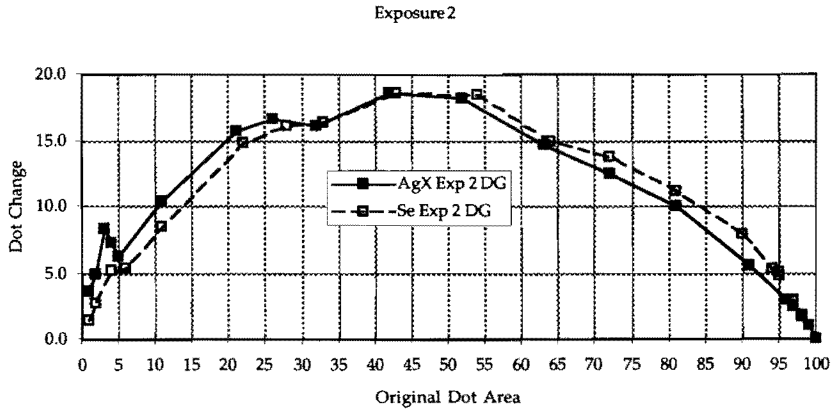

Chart 2

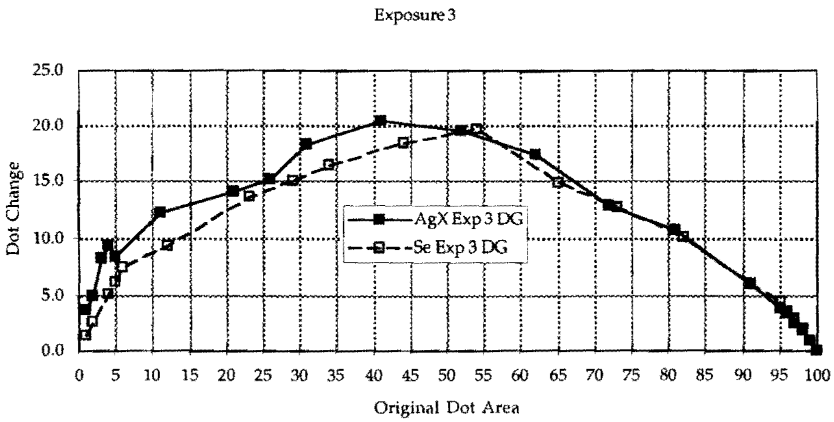

Chart 3

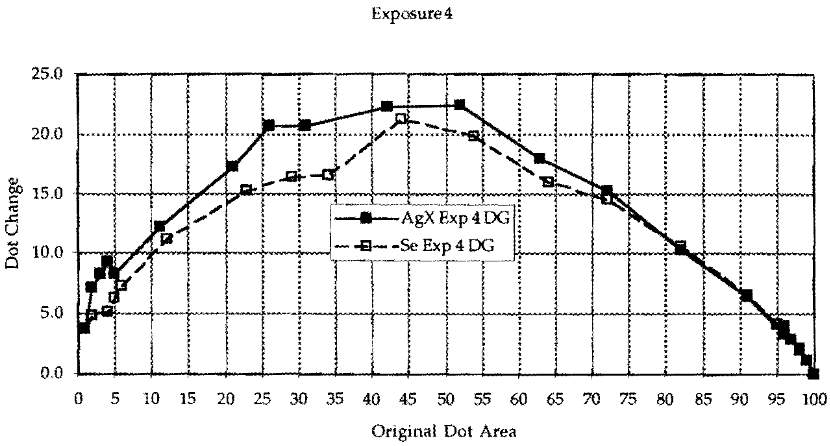

Chart 4

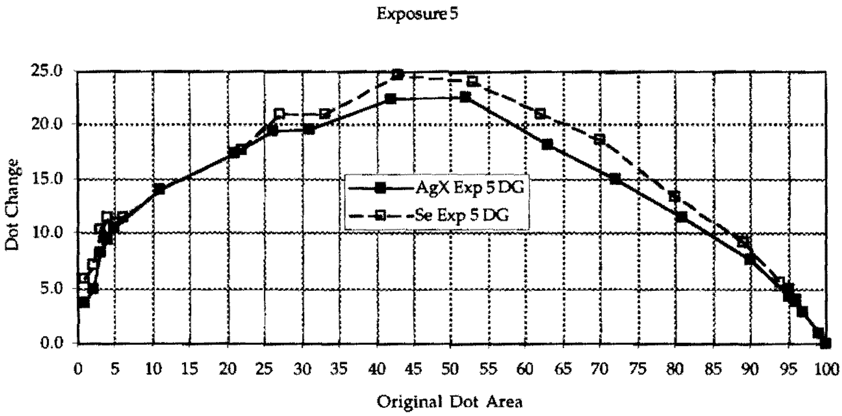
Exposure 5
Dot Change
25.0
20.0
15.0
10.0
5.0
0.0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Original Dot Area
AgX Exp 5 DG
Se Exp 5 DG

Chart 5

AgX Dot Gain Readings

Film % Dot	AgX Exp 5 DG	Film % Dot	AgX Exp 4 DG	Film % Dot	AgX Exp 3 DG	Film % Dot	AgX Exp 2 DG	Film % Dot	AgX Exp 1 DG
1	3.7	1	3.7	1	3.7	1	3.7	1	3.7
2	4.9	2	7.1	2	4.9	2	4.9	2	4.9
3	8.3	3	8.3	3	8.3	3	8.3	3	8.3
4	9.4	4	9.4	4	9.4	4	7.3	4	7.3
5	10.5	5	8.4	5	8.4	5	6.3	5	8.4
11	14.1	11	12.2	11	12.2	11	10.3	10	11.3
21	17.3	21	17.3	21	14.2	21	15.8	21	12.6
26	19.5	26	20.7	26	15.2	26	16.7	26	13.8
31	19.6	31	20.7	31	18.3	32	16.0	31	15.7
42	22.4	42	22.3	41	20.4	42	18.5	41	18.5
52	22.6	52	22.5	52	19.6	52	18.2	51	18.4
63	18.1	63	18.0	62	17.4	63	14.7	62	15.7
72	15.0	72	15.2	72	12.8	72	12.4	71	13.4
81	11.5	82	10.3	81	10.8	81	10.0	81	9.4
90	7.6	91	6.4	91	6.0	91	5.6	91	5.4
95	4.3	96	3.3	95	3.9	96	3.0	95	4.0
96	3.8	96	3.7	96	3.5	97	2.4	96	3.3
97	2.8	97	2.8	97	2.6	98	1.6	97	2.5
99	1.0	98	2.1	98	1.9	98	1.8	98	2.0
99	1.0	99	1.2	99	0.9	99	1.1	99	1.1
100	0.0	100	0.0	100	0.0	100	0.0	100	0.0

Table 1

Se Dot Gain Readings

Film % Dot	Se Exp 5 DG	Film % Dot	Se Exp 4 DG	Film % Dot	Se Exp 3 DG	Film % Dot	Se Exp 2 DG	Film % Dot	Se Exp 1 DG
1	5.9	1	3.7	1	1.4	1	1.4	1	-1.0
2	7.1	2	4.9	2	2.7	2	2.7	2	2.7
3	10.4	4	5.1	4	5.1	4	5.1	4	2.9
4	11.4	5	6.3	5	6.3	4	5.1	4	5.1
6	11.4	6	7.4	6	7.4	6	5.3	6	5.3
11	14.0	12	11.2	12	9.3	11	8.4	12	7.5
22	17.8	23	15.3	23	13.7	22	14.8	22	11.7
27	21.0	29	16.4	29	15.0	28	16.1	27	14.3
33	21.1	34	16.5	34	16.5	33	16.4	33	15.1
43	24.7	44	21.2	44	18.4	43	18.5	43	17.6
53	24.0	54	19.8	54	19.8	54	18.5	54	17.1
62	21.0	64	16.0	65	14.9	64	14.9	64	14.4
70	18.7	72	14.5	73	12.7	72	13.8	72	13.0
80	13.3	82	10.6	82	10.0	81	11.2	80	11.5
89	9.2	91	6.7	91	6.0	90	7.9	89	8.2
94	5.6	95	4.1	95	4.5	94	5.3	94	5.5
95	5.0	96	3.6	96	3.6	95	4.8	95	4.9
95	4.8	96	4.0	97	2.7	95	5.1	95	5.0
96	3.8	96	3.9	97	2.9		#VALUE!	96	4.0
96	3.9	96	3.9	97	2.9	97	2.9	98	2.2
96	4.0	98	2.0	98	2.0	97	3.0	98	2.0

Table 2

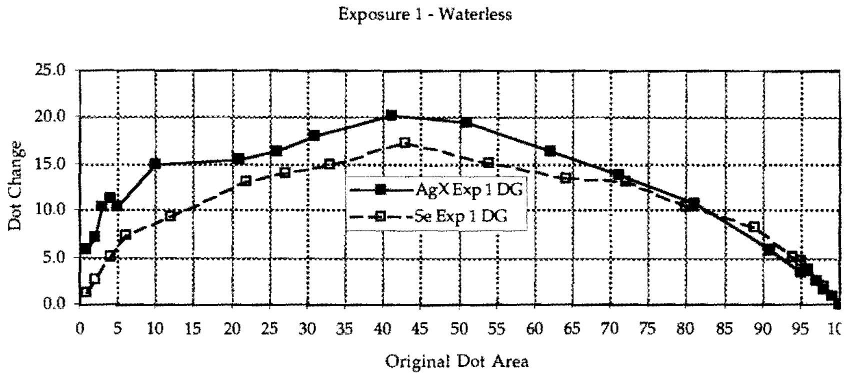

Chart 6

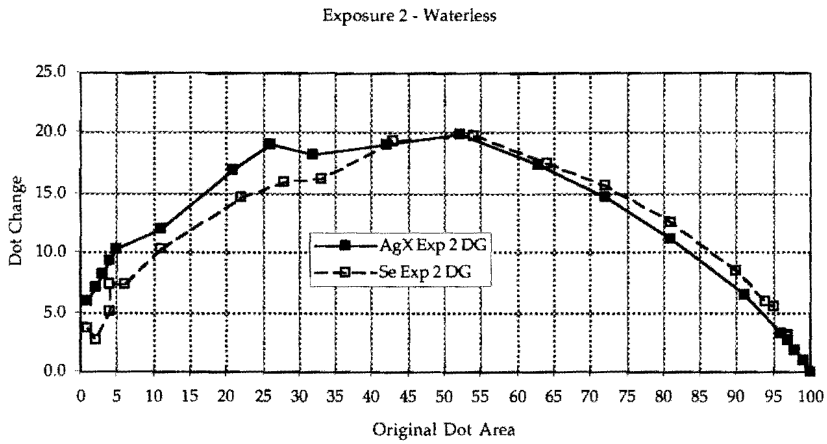

Chart 7

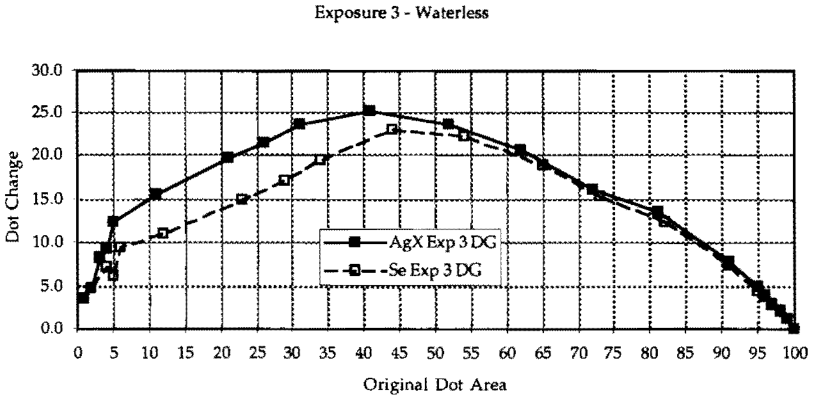

Chart 8

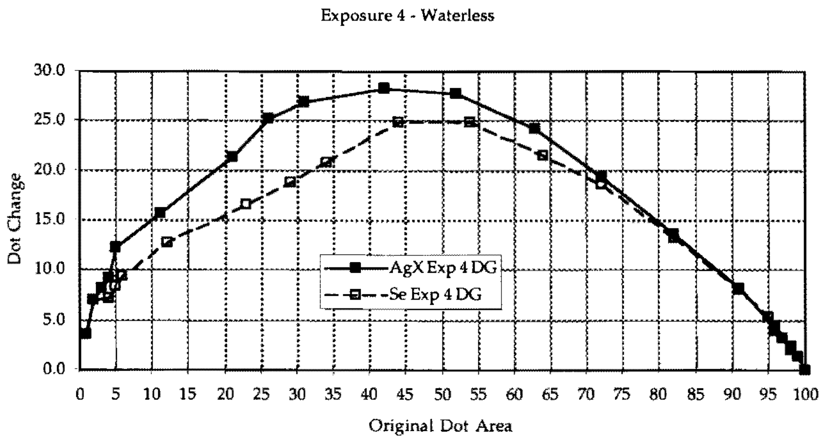

Chart 9

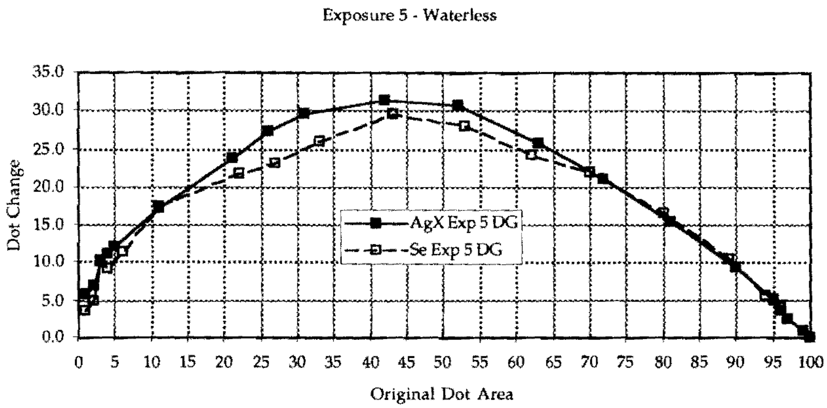
Exposure 5 - Waterless
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Dot Change
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Original Dot Area
AgX Exp 5 DG
Se Exp 5 DG

Chart 10

AgX Dot Change Readings - Waterless

Film % Dot	AgX Exp 5 DG	Film % Dot	AgX Exp 4 DG	Film % Dot	AgX Exp 3 DG	Film % Dot	AgX Exp 2 DG	Film % Dot	AgX Exp 1 DG
1	5.8	1	3.6	1	3.6	1	5.9	1	5.9
2	7.0	2	7.0	2	4.8	2	7.1	2	7.1
3	10.2	3	8.2	3	8.2	3	8.2	3	10.3
4	11.2	4	9.3	4	9.2	4	9.3	4	11.4
5	12.2	5	12.3	5	12.3	5	10.3	5	10.4
11	17.2	11	15.6	11	15.5	11	12.0	10	14.9
21	23.8	21	21.3	21	19.8	21	17.0	21	15.6
26	27.4	26	25.3	26	21.5	26	19.1	26	16.5
31	29.7	31	26.9	31	23.6	32	18.2	31	18.1
42	31.5	42	28.3	41	25.2	42	19.0	41	20.2
52	30.8	52	27.8	52	23.6	52	19.9	51	19.6
63	25.9	63	24.3	62	20.6	63	17.4	62	16.5
72	21.0	72	19.3	72	16.1	72	14.7	71	13.9
81	15.6	82	13.7	81	13.4	81	11.2	81	10.7
90	9.4	91	8.2	91	7.8	91	6.4	91	5.9
95	4.9	96	4.2	95	4.9	96	3.2	95	3.4
96	3.7	96	4.4	96	3.8	97	2.7	96	3.6
97	2.4	97	3.2	97	2.8	98	1.9	97	2.6
99	1.0	98	2.4	98	2.2	98	1.8	98	1.6
99	0.9	99	1.3	99	1.2	99	1.0	99	1.0
100	0.0	100	0.0	100	0.0	100	0.0	100	0.0

Table 3

Se Dot Change Readings - Waterless

Film % Dot	Se Exp 5 DG	Film % Dot	Se Exp 4 DG	Film % Dot	Se Exp 3 DG	Film % Dot	Se Exp 2 DG	Film % Dot	Se Exp 1 DG
1	3.6	1	3.6	1	3.6	1	3.7	1	1.4
2	4.9	2	7.1	2	4.8	2	2.7	2	2.7
3	10.3	4	7.2	4	7.1	4	5.1	4	5.1
4	9.3	5	8.3	5	6.1	4	7.3	4	5.1
6	11.3	6	9.3	6	9.3	6	7.4	6	7.4
11	17.4	12	12.9	12	10.9	11	10.3	12	9.3
22	21.7	23	16.5	23	14.8	22	14.7	22	13.1
27	23.2	29	18.7	29	17.2	28	16.0	27	14.1
33	26.1	34	20.8	34	19.4	33	16.3	33	14.9
43	29.6	44	24.9	44	23.0	43	19.4	43	17.4
53	28.0	54	24.8	54	22.2	54	19.8	54	15.2
62	24.3	64	21.5	65	18.9	64	17.5	64	13.5
70	22.0	72	18.6	73	15.4	72	15.6	72	13.1
80	16.7	82	13.3	82	12.4	81	12.5	80	10.5
89	10.5	91	8.1	91	7.4	90	8.5	89	8.1
94	5.6	95	5.3	95	4.3	94	6.0	94	5.2
95	4.9	96	4.2	96	3.9	95	5.5	95	4.7
95	5.1	96	4.1	97	2.9	95	5.5	95	4.7
96	4.1	96	4.1	97	2.7		#VALUE!	96	3.7
96	4.2	96	3.9	97	2.9	97	3.1	98	2.1
96	4.0	98	2.0	98	2.0	97	3.0	98	2.0

Table 4