EVALUATION OF WET PICK AND WET REPELLANCE TENDENCY OF PAPER WITH THE IGT PRINTABILITY TESTER AIC2-5.

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ABSTRACT:

A method of dampening paper on the IGT AIC2-5 printability tester is described. Using this method the tendency to wet pick and wet repellance of paper can be evaluated. To increase the amount of dampening fluid transferred during the test a new set of dampening discs for the AIC2-5 printability tester has been developed. With the new discs it is possible to further distinguish between papers of the same kind, but with slightly different tendencies to the influence of dampening. A method of determination of transferred amount of dampening fluid is described. Tests with a number of different papers using the new dampening system are described and the test results discussed.

INTRODUCTION

In offset printing, the fact that water as well as ink are transferred to paper may well lead to complications. Especially in process printing, where the paper is wetted several times, water may affect ink transfer because it changes the surface structure of the paper. For example, the water can weaken the paper surface to such an extent that paper particles are pulled from the surface by the tack of the ink. This phenomenon is known as wet pick. Another possible effect of water is that the paper does not accept ink. This is called wet repellance. Both phenomena may occur simultaneously and sometimes it is difficult to differentiate between them, because they both appear as white spots in the print.

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During offset printing a moisture film of approximately 0.3 µm is applied to the paper. To investigate and check a moisture film of this thickness an accessory to the IGT printability testers is available: the dampening unit. With the regular rubber coated dampening disc a film of 0.3 µm can be applied. A new set of dampening discs has been developed for film thicknesses 0.5, 1.0 and 1.5 µm.

IGT PRINTABILITY TESTER AND DAMPENING UNIT

The IGT printability tester AIC2-5. The AIC2-5 tester (figure 1) is widely used in the graphic arts industry and by suppliers of the industry, such as papermills and ink-makers. Its main features are the sector and two printing

Figure 1. IGT printability tester AIC2-5

shafts. The sector serves as an impression cylinder, against which one or two printing discs (printing formes) are placed. The operation is based on the round-round principle, the same as is common in printing presses. The tester is designed mainly for applications related to offset and letterpress printing.

The dampening unit. The dampening unit (figure 2) consists of a dampening disc which transfers the moisture film to the paper. In the process an excess of dampening fluid is applied to the disc, which is then metered by a doctor blade to the quantity found in offset presses. The excess is obtained by placing a wad of lint free cotton-wool soaked in dampening fluid just before the doctor blade. The unit is provided with a weight by which the doctor blade is kept in close contact with the dampening disc and the metering of the moisture film is made possible. The dampening unit is attached to the IGT printability tester by means of a pin in the top accessory hole.

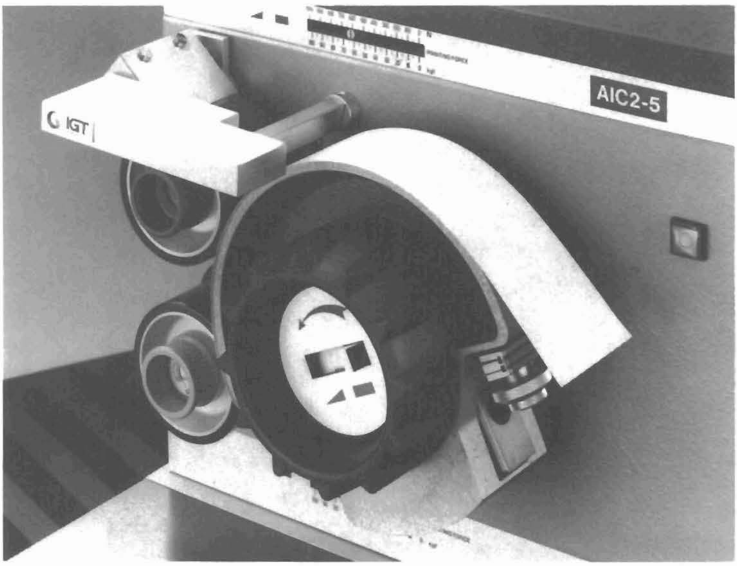


Figure 2. Dampening unit on AIC2-5 printability tester.

Method. In carrying out the test the dampening disc is placed on the top shaft and the printing disc on the lower shaft. Normally the printing disc is narrower than the dampening disc, in order to ensure the teststrip is moistened over the full width of the printing area and to avoid possible irregularities at the edges. Both the dampening disc and the printing disc are set at a printing force of 125 N/cm. After that the printing disc is removed to be inked. The required printing speed is adjusted and if desired the interval time as well. A strip of the substrate to be tested is clamped on the sector, the inked printing disc placed on the lower shaft and a print is made.

Evaluation. The result is evaluated on the last part of the teststrip, as that part is supplied with the proper amount of dampening fluid. Often it is difficult to differentiate between wet pick and wet repellance. Therefore the printing disc has to be examined together with the teststrip. In case of wet pick, paper particles are visible on the printing disc, which is never the case for wet repellance. To ease the determination of wet pick/wet repellance it is recommended to make a second print with the same printing disc on an art paper. In case of wet pick, the second printed image will be similar to the first. When wet repellance has occurred, a thicker layer of ink will be applied on the spots where no ink was transferred during the first print. As a result these areas will show a darker colour.
Usually the evaluation is done visually, while using one or two standards of reference. Also the density of the print may be measured and compared with the density of the standard prints.

THICKER MOISTURE FILMS

Earlier experiments show that with the conventional rubber coated dampening discs moisture films of 0.2 to 0.3 μm thickness can be transferred to the paper. This is approximately the amount of moisture transfer during one printing pass in an offset press. In this way a two-colour press is simulated.
To simulate a four-colour press, the wetting has to be done three times. For this purpose the paper is brought three times into contact with the dampening disc and ink is applied during the last pass. This method of applying

thicker films is not very accurate because of the time lapse between the several passes.
For this reason a new type of dampening disc has been developed. A further reason was the need to apply thicker moisture films to allow differentiation between papers that are good and excellent with regards to wet pick and/or wet repellance. Because of the larger moisture quantity wet pick and wet repellance will appear sooner in the good papers than in the excellent grades.
To enable the transfer of these thicker films the dampening discs are provided with a screen pattern, similar to anilox rollers in flexography and printing forms in gravure. The test conditions have to be changed only slightly, in that the sector has to be covered with a paper packing to avoid possible damage caused by the hard surface of the dampening discs. The new dampening discs have been engraved electronically on an engraving machine for gravure cylinders. This manner of manufacture allows very close control of cell structure and volume. It is assumed that the volume of the cells is directly related to the moisture film thickness. Standard quality control equipment for gravure cells enables accurate measurement of the theoretical cell volume of the dampening discs. This garantees the manufacture of the discs in a reproducible manner.

CHECKING THE FILM THICKNESS

In addition it is necessary to determine the actual moisture transfer to the teststrip.

Principle. The moisture film thickness on the teststrip can be determined by means of a colour reaction test. There is a number of conditions that have to be fulfilled: the determination must be easy to be done on paper; the method has to be sensitive; the reagent may not interact with components of the teststrip; the colour obtained must not fade, etc. A suitable method was found by adding a nickel salt to the dampening fluid and causing change of colour by reacting with dimethylglyoxime. The colour, which is a function of the number of ions present on the paper, is measured with a densitometer.
By using the standard IGT testing method for measuring the surface roughness of paper it is possible to transfer a moisture film of a fixed thickness onto paper. In this testing method a small, accurately determined quantity of dampening fluid is spread over the paper, forming an oval

spot, the fluid filling the surface irregularities. By making these spots with solutions containing different concentrations of nickel ions it is possible to plot a calibration diagram, in which the density is plotted as a function of the product of concentration and film thickness.

<u>Calibration diagram.</u> A calibration diagram was made for art paper used in standard tests. In carrying out the determination two strips of art paper are placed in the clamp of the AIC2-5. One strip is placed over an aluminium

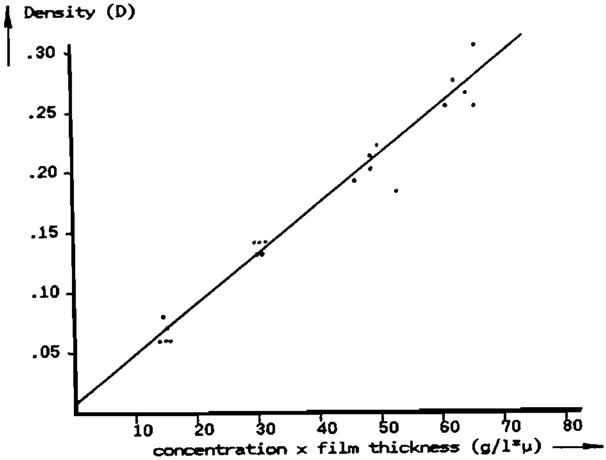


Figure 3. Calibration diagram for art paper.

printing disc mounted on the top shaft. The other strip over the rubber blanket on the sector. On the strip over the printing disc a drop of laquer is placed in order to prevent the solution penetrating into the paper in the time lapse between applying the liquid and the spreading. By means of a micro-syringe 1.00 mm^3 of a nickel sulphate solution of a known concentration is placed on the (dry) laquer. The printing force is adjusted to 200 N/cm and the speed increasing to 3 m/s. The dry strip is developed in a 1% alcoholic dimethylglyoxime solution and held over ammonia. The surface of the spot formed is determined planimetrically and the volume per surface unit, hence the film thickness, can be calculated. After that the density of the spot is determined with a densitometer.

With 2%, 4%, 6% and 8% nickel sulphate solutions five roughness spots per concentration have been made. The calibration diagram (figure 3) is made by plotting the density (D) as a function of the product of concentration and film thickness ($g/l*\mu$).
Using a statistical correlation program a linear regression was calculated with the paired variables (D) and ($g/l*\mu$) in this calibration diagram. The correlation coefficient with this set of variables is better than 0.985.

Wetting the paper. In determinating the moisture transfer from dampening disc to substrate the dampening disc is placed on the top shaft of the AIC2-5 printability tester. The doctor blade unit is attached. Printing force is set to 125 N/cm and printing speed to 3 m/s. An excess of dampening fluid is applied by placing a wad of lint free cotton wool just before the doctor blade. The cotton wool is soaked with nickel sulphate of a known concentration. By pressing the two starting buttons of the AIC2-5 the dampening disc is rolling over the sector, the dampening fluid is metered by the doctor blade and transferred to the paper strip.
After reaction with dimethylglyoxime the density is measured and the dampening fluid transfer is determined using the calibration diagram.

Results. The moisture transfer of the four dampening discs have been measured this way. The results are:

Table 1.

Dampening disc	moisture transfer in μm
conventional rubber coated disc	0.2 - 0.3 μm
screened dampening disc 1	0.5 μm
screened dampening disc 2	1.0 μm
screened dampening disc 3	1.5 μm

EXPERIMENTAL

Experiments with this set of new discs have shown remarkable results. A number of paper and board substrates have been tested.

Shown here are the results of tests with four grades of the same LWC-paper. Originally this paper was showing a wet pick tendency, and was adjusted for that. The following parameters have been varied:

Table 2.

moisture film:	0.2 - 0.3 μm 0.5 μm 1.0 μm 1.5 μm
interval time:	0.023 s (3 m/s) 0.07 s (1 m/s) 3 s

Figures 4 through 10 give a summary of the wet pick/wet repellance tests on the four paper grades, marked A, B, C and D. The tests have been performed on 50 mm wide paper strips and the printed image has a width of 32 mm. In each test the first print was done on the paper under examination and the second print on art paper comparison strips (grade Ka, 150 gsm). The dampening fluid consists of water with 10% isopropyl alcohol and the ink used is the standard IGT offset ink.

Because of the limited space the testresults have been cut in small strips with the position of the wetting centred. This allows the comparison of the wet pick/wet repellance tendency under the different test conditions.

Apart from the influence of the moisture film thickness there is a significant influence of the interval time, that is the time lapse between the dampening and the printing. This lapse is either governed by the printing speed or can be set by means of the interval timer of the AIC2-5.

Figure 4 shows the testresults of paper A with increasing moisture film thickness (0.3, 0.5, 1.0 and 1.5 μm) at a interval time of 0.023 s (printing speed 3 m/s). The

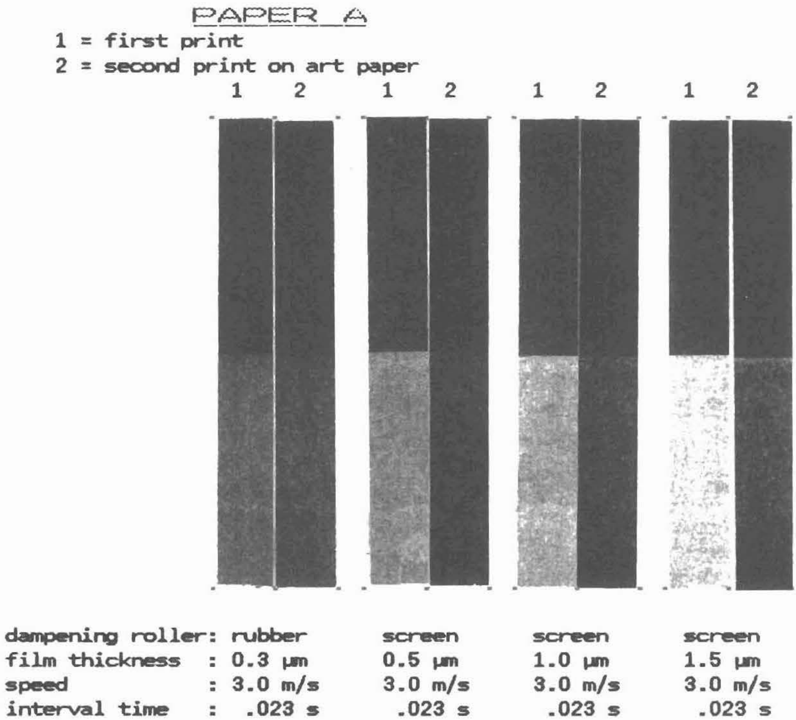


Figure 4. Paper A moisture film thickness 0.3, 0.5, 1.0 and 1.5 μm, interval time 0.023 s (speed 3 m/s)

increase in moisture film thickness results in an increased wet repellance. Besides there is wet pick in all four situations.
The testresults of paper A at a interval time of 0.07 s (printing speed 1 m/s) and increasing moisture film thickness are given in figure 5. Here again the increase in moisture film thickness results in an increased wet repellance. There is wet pick in all four situations.
Comparing the influence of the interval times in paper A shows an increase in wet pick at the longer interval time. Figure 6 gives the influence of the interval time on paper A with a moisture film thickness of 1.5 μm. From these results

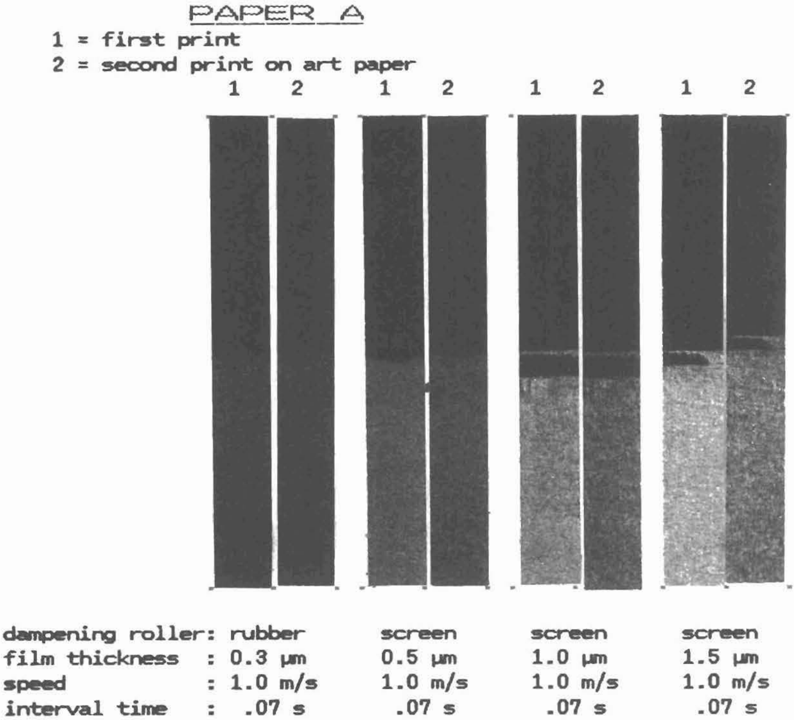


Figure 5. Paper A moisture film thickness 0.3, 0.5, 1.0 and 1.5 μm, interval time 0.07 s (speed 1 m/s)

it can be seen that the wet pick is increasing when the time lapse between the dampening and the printing is lengthened. Evaluation of all testresults of paper A proves that paper A has a tendency to wet pick from the very start (0.3 μm, 0.023 s) and on top of that is showing an increasing wet repellance tendency with enlarged moisture films.
Figure 7 shows the testresults of paper D with increasing moisture film thickness (0.3, 0.5, 1.0 and 1.5 μm) at a interval time of 0.023 s (printing speed 3 m/s). The increase in moisture film thickness results in an increased wet repellance. Besides there is no wet pick in any of the situations.

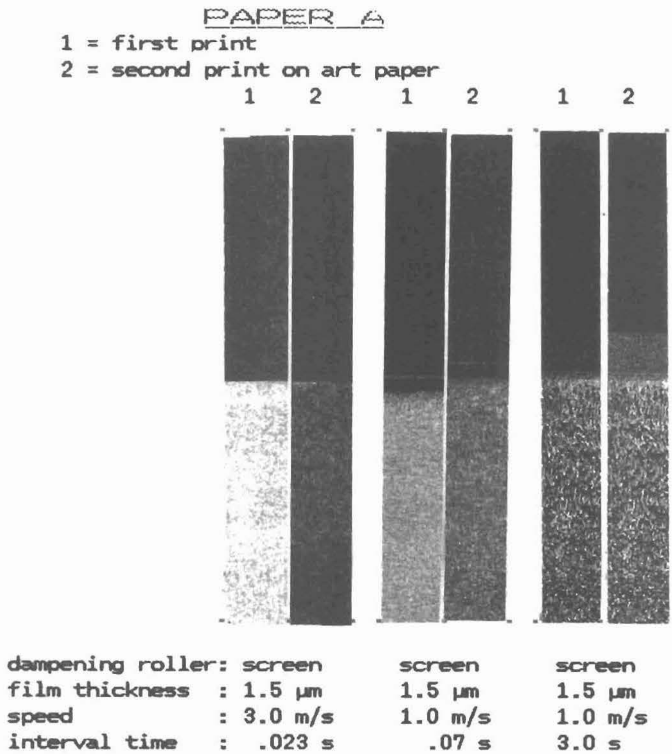


Figure 6. Paper A moisture film thickness 1.5 μm, interval times 0.023 s, 0.07 s and 3.0 s.

The testresults of paper D at a interval time of 0.07 s (printing speed 1 m/s) and increasing moisture film thickness are given in figure 8. Here again the increase in moisture film thickness results in an increased wet repellance. In all cases no wet pick has been noticed. There is no wet repellance either at moisture film thickness 0.3 μm and interval time 0.07 s.

Comparing the influence of the interval times in paper D shows a decrease in wet repellance at the longer time. Figure 9 gives the influence of the interval time in paper D with a moisture film thickness of 1.5 μm. It is interesting to see that the initial strong wet repellance at the interval time of 0.023 s is changing to wet pick without wet repellance at the interval time of 3.0 s.

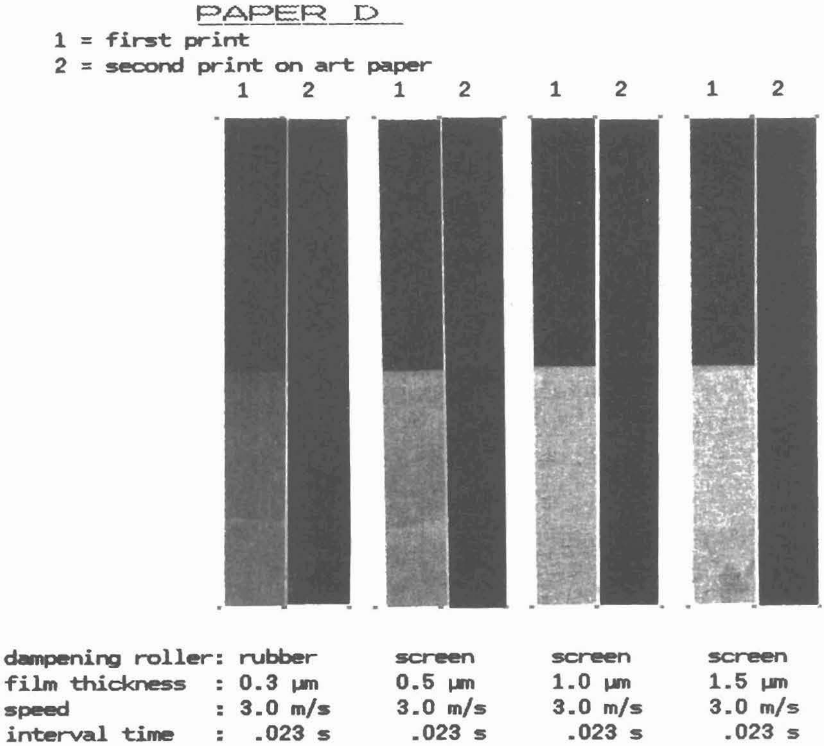


Figure 7. Paper D moisture film thickness 0.3, 0.5, 1.0 and 1.5 μm, interval time 0.023 s (speed 3 m/s)

Evaluation of all testresults of paper D proves that paper D has a tendency to wet repellance from the very start (0.3 μm, 0.023 s) without wet pick at the shorter interval times. Besides it is showing a decrease in wet repellance with enlarged interval times, which is even changing to wet pick at interval time 3.0 s.
The testresults of paper B show very much the same tendencies as paper D.
Figure 10 gives the influence of the interval time in paper C with a moisture film thickness of 1.5 μm. Here is no wet pick at all and a strong wet repellance at the interval time of 0.023 s that is changing to no wet repellance at the interval time of 3.0 s.

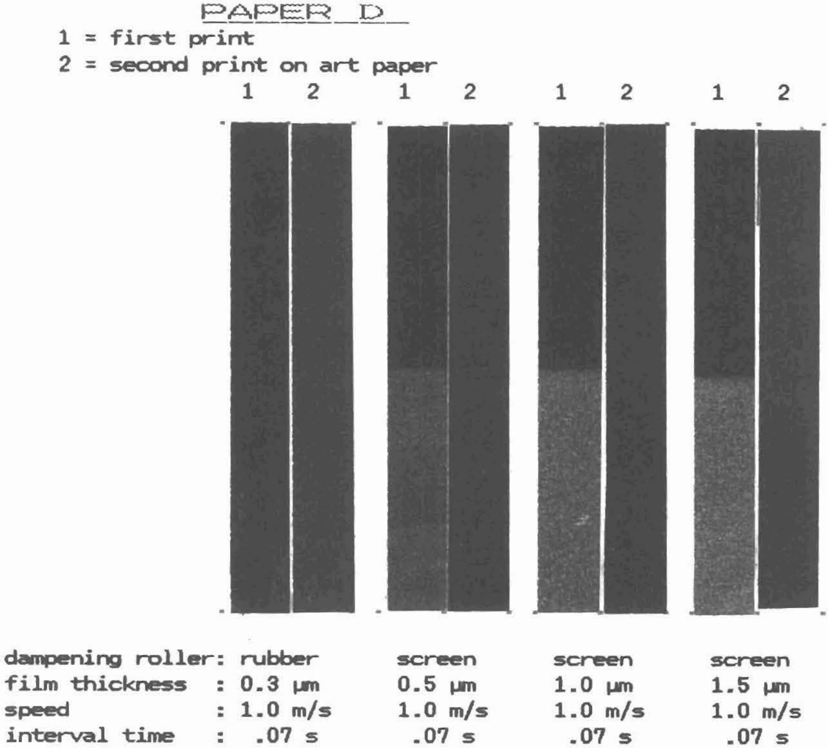


Figure 8. Paper D moisture film thickness 0.3, 0.5, 1.0 and 1.5 μm, interval time 0.07 s (speed 1 m/s)

In conclusion it can be said that of the four paper grades grade A gives wet pick and wet repellance at the test with the conventional rubber coated dampening disc. Grades B, C and D show a low wet repellance under the same conditions. Adding to the moisture film thickness results in an increased wet repellance in paper B, C and D. Increasing the interval time results in paper A in an overall increase in wet pick; in paper B and D in a decrease in wet repellance and a change to wet pick at the 3.0 s interval; paper C shows a decrease in wet repellance and no wet pick at all. As far as wet pick/wet repellance is concerned paper C is best.

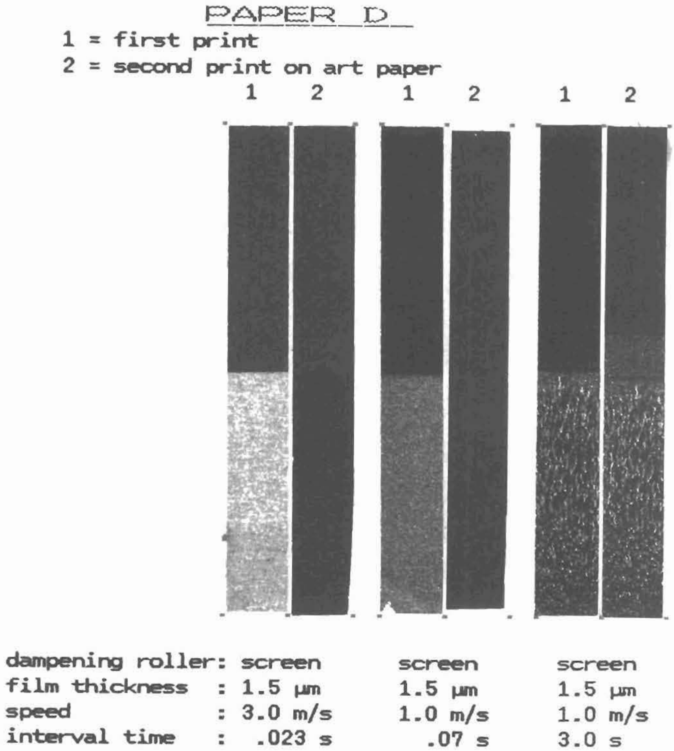


Figure 9. Paper D moisture film thickness 1.5 μm, interval time 0.023 s, 0.07 s and 3.0 s.

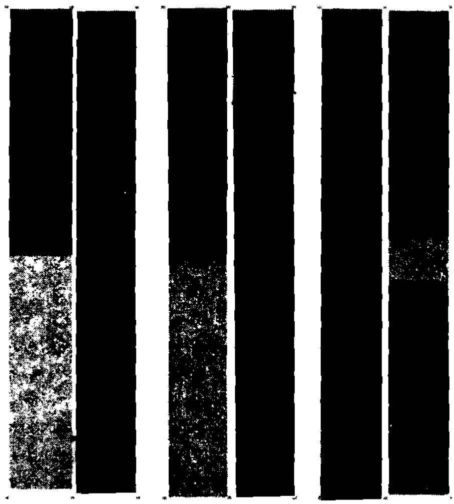
The new set of dampening disc has had other uses as well, for instance: In a certain type of plastic substrate that was printed on in offset there were complaints as to the runnability of the substrate, where as a rule this was not the case. Testing with the conventional dampening rubber covered disc did not show wet repellance tendency. However, by applying a thicker moisture film with the new dampening discs wet repellance occured in the substrate that gave rise to the complaints and not in the other, apparently the same, material. Thus it was shown that the plastic substrate came from two different production batches.

PAPER C

1 = first print

2 = second print on art paper

1 2 1 2 1 2



dampening roller:	screen	screen	screen
film thickness :	1.5 µm	1.5 µm	1.5 µm
speed :	3.0 m/s	1.0 m/s	1.0 m/s
interval time :	.023 s	.07 s	3.0 s

Figure 10. Paper C moisture film thickness 1.5 μm, interval time 0.023 s, 0.07 s and 3.0 s.

CONCLUSION

The new dampening discs are very suitable to differentiate between good and excellent papers with regards to wet pick and wet repellance tendency. Because of the larger moisture quantity wet pick and wet repellance will appear earlier in good papers than in excellent grades.

In the first place the new discs are meant for research purposes. They are not directly needed in daily practice as tests with the conventional rubber coated dampening discs are sufficiently accurate for most applications.