Ink setting and back trap mottle

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ABSTRACT

Paper coating can give smoothness surface and good printability to uncoated paper. Macro roughness of base paper would be decreasing its groove and grit in view of side. Nevertheless its improving effect for paper, some kind of problem is showing in the fine coated paper. Especially, back trap mottle is one of serious problems in printing with fine coated paper. Printers can not adjust conditions to overcome the problem. Also large amounts of paper can be rejected. There are many factors that influence back trap mottle. However it is not clear what the important parameters are in back trap mottle. Back trap mottle has some relationship with ink setting but good guidelines are not clear. Back trap mottle has been linked to non-uniform ink setting. We do not know how much variation in setting we can tolerate. Other mottle issues such as micro-picking and ink refusal are still common.

This paper was prepared to identify correlation with ink setting and delta ink density obtained from experiment and then tried to find out some relationships with ink setting and back trap mottle. Basically fine calcium carbonate and clay was used for main components and coarse calcium carbonate was mixed in two fine pigments to change its porosity and ink acceptance. Micro ink tack force at KRK printing tester was adapted to measure ink setting rate. KRK units were used for back trap mottle simulation and two printed samples were prepared to check delta ink density.

Clay base coating has more fast ink setting time than calcium carbonate's though smoothness of clay was better than calcium carbonate. It could be explained by that clay has finer pore in its coating than calcium carbonate. DID(delta ink density) has shown a good correlation with ink setting time from micro ink tack. The total pore volume of coating layer did not match with ink setting and DID. From the results we might conclude coating that has fine pore size around 0.05 μm can be exposed to high possibility of back trap mottle.

INTRODUCTION

Print quality is varying from paper to paper because some ingredients in ink like varnish can easily penetrate and spread through pores. Due to its absorption differences, ink density and gloss are showing different results. Mottle is one of the results from different ink absorption and remaining on the paper.

There are two big reasons for print mottle, back trap and ink refusal mottle. It is well known that back trap mottle is originated by difference to take in the ink ingredients because of too dense structure. Also ink refusal mottle is occurred when the substrate has difficult condition to absorb dampening water in the printing process so the ink can remain its surface that they re-attach on the blanket of next print process. The common phenomenon of two mottle patterns is irregular ink density after printing. It is very difficult to accept its irregular printing results to the final customers. To identify its reason, researchers focused on coating or ink formulations. However, the basic reason for any kind of mottle has same root of structure difference. If they have very unique structure on surface, it is very seldom to find ink density variations on same printing image area.

Therefore we established the hypothesis that if the coating layer has different ink absorption or remaining on the sample, it will be detect from ink density. To identify its effect on the mottle, laboratory printing test was adopted to simulate back trap mottle. The samples from this experiment were used to measure delta ink density. To do understand the mechanism of liquid penetration, mercury porosimeter is still very effective device to check pore size and distribution of paper. In this research, the result from porosimeter was very useful to understand ink setting rate and time. From this research, we tried to find out relationship with ink setting and back trap mottle and correlation with delta ink density and ink setting rates.

EXPERIMENTTAL PROCEDURE

Materials

- Pigments: GCC (Omya HC60, HC90), Clay90 (Huber Hydragloss90)
- Latex: S/B latex (Dow650NA)
- Base paper : 76gram Woodfree
- Ink: Off-set ink (Sun chemcial, Cyan)

Experiments

- Draw down coater, target in 10grams, dried in 105℃ oven
- KRK printing tester for printing sample and simulating back trap
- Micro Ink tack and dynamic gloss meter to detect setting rate
- DID (Delta Ink Density) = DP0 – DP1, DP1 – DP2
- Mercury pore sizer

Table 1. DID test series.

ITEMS	INK ROLL 1	INK ROLL 2
DP -0	ON	OFF
DP -1	ON	ON
DP-2	ON	ON
	REPEAT	

* DP1 AND 2 induced backtrap mottle from using blank roll on 2nd roll. The ink was applied only on 1st roll. DP-2 was repeated procedure of DP-1.

Table 2. Calcium carbonate base coating formulations.

Iitems	GT1	GT2	GT3	GT4	GT5
GCC60, pph	0	10	30	40	100
GCC90, pph	100	90	70	60	0
Latex , pph	10	10	10	10	10
T.S.C. , %	65	65	65	65	65

Table 3. Clay base coating formulations.

Iitems	GT1	GT2	GT3	GT4
GCC60, pph	0	10	30	40
Clay90, pph	100	90	70	60
Latex , pph	10	10	10	10
T.S.C. , %	65	65	65	65

Calendering was performed at laboratory calender. Applied linear pressure for calcium carbonate and clay base coated sample was respectively 52 and 121 KN/m.

RESULTS AND DISCUSSIONS

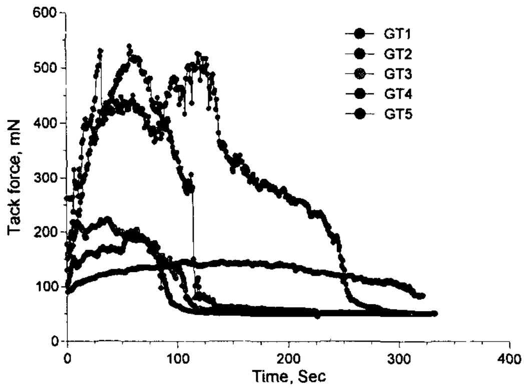


Fig.1. Ink setting on calcium carbonate base coated paper.

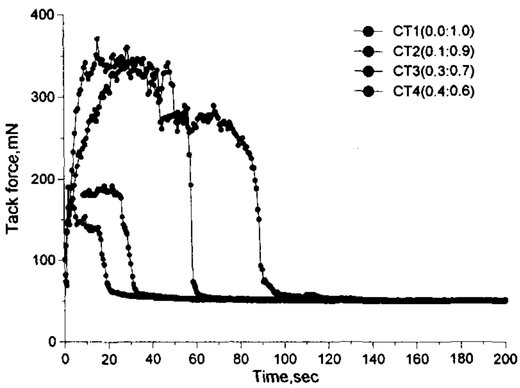


Fig.2. Ink setting on clay base coated paper.

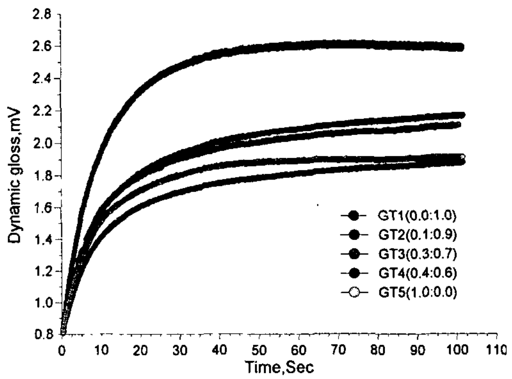


Fig.3. Dynamic gloss results on calcium carbonate base coated

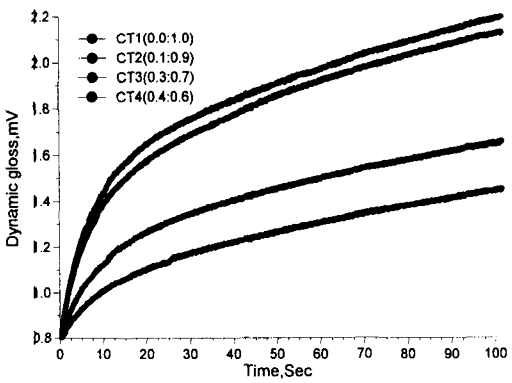
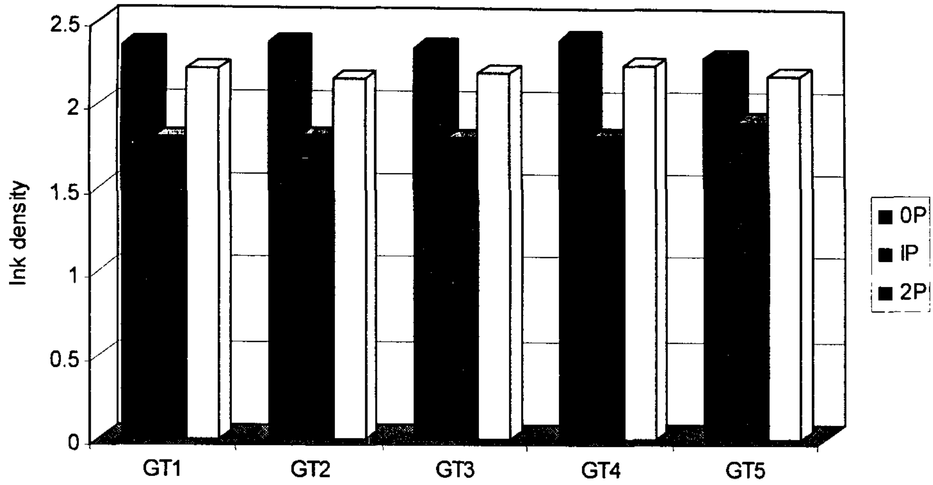


Fig.4. Dynamic gloss results on clay base coated paper.



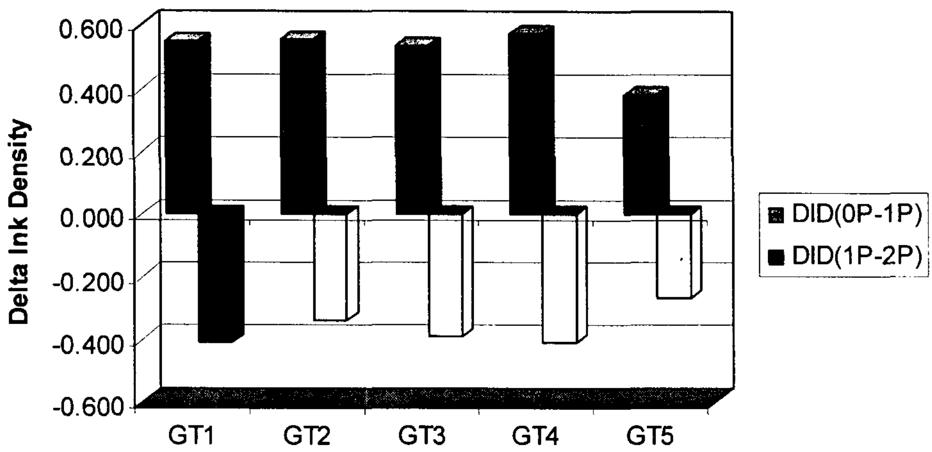
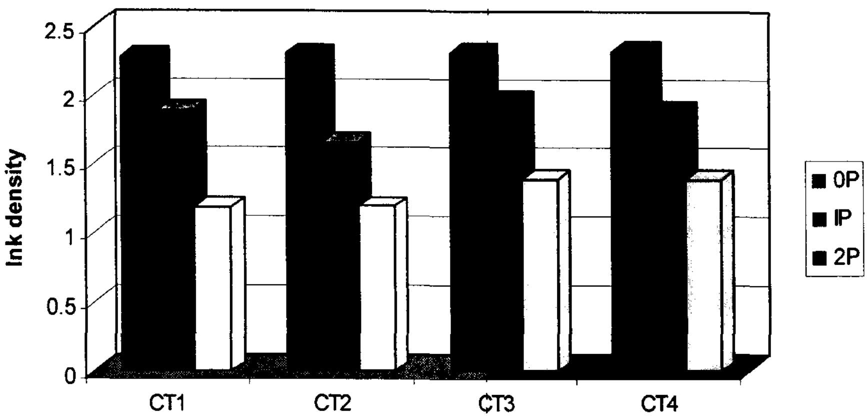


Fig.5. Delta ink density after multi pass, calcium carbonate base



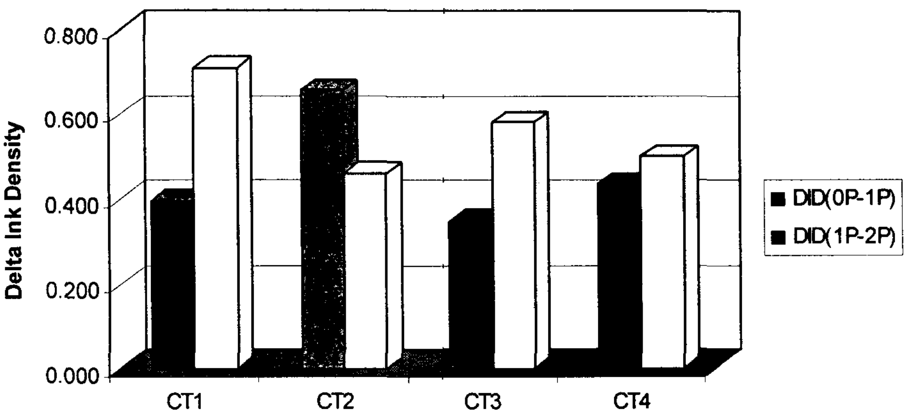


Fig.6. Delta ink density after multi pass, clay base.

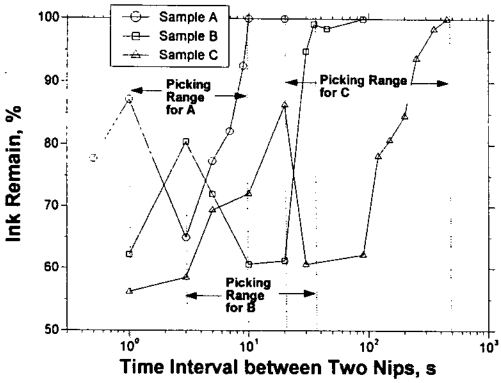


Fig.7. Ink remain (%) after 2nd nip as a function of time interval between two nips

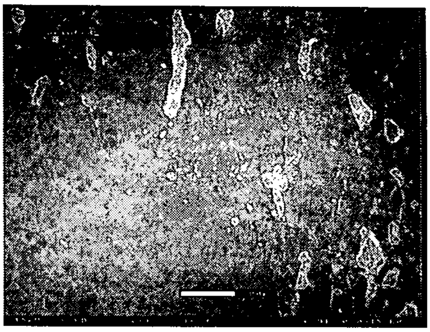


Fig.8. Micro-picking happens because of

- Sample A: 162 g/m2, HP Inkjet very fast setting coating layer
- Sample B: 146 g/m2, coated paper, more open coating than C
- Sample C: 175 g/m2, coated paper

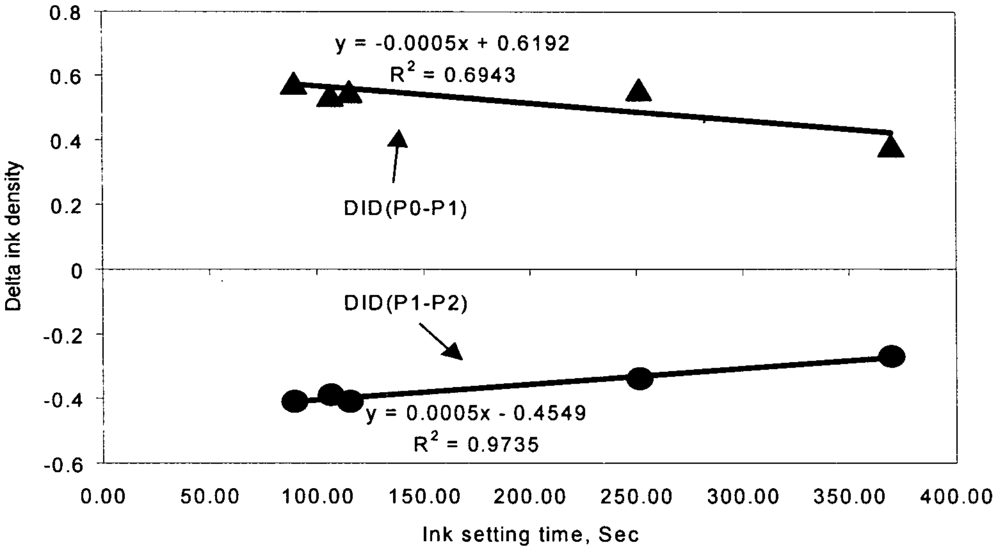


Fig.9. Correlation with DID and ink setting time, calcium carbonate base.

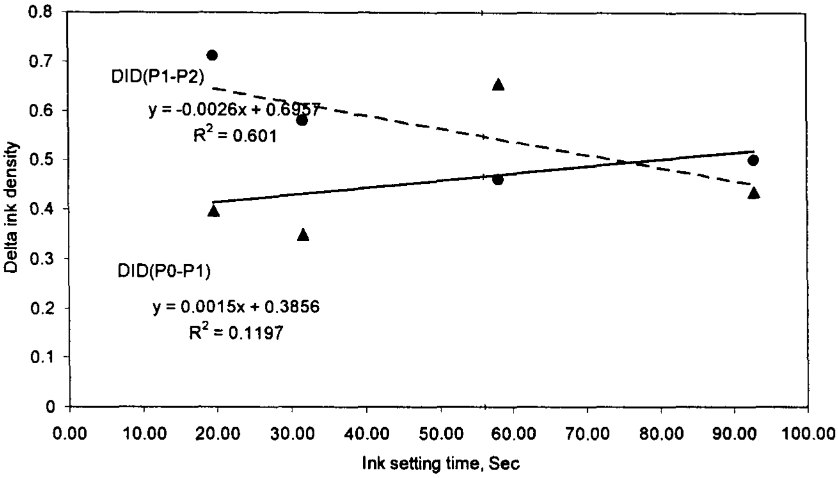


Fig.10. Correlation with DID and ink setting time, clay base.

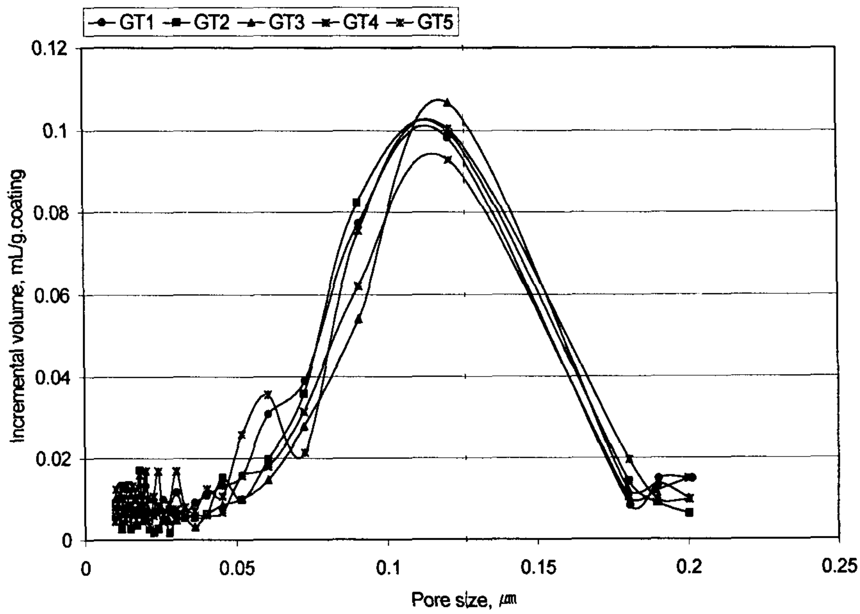


Fig.11. Pore size distribution, calcium carbonate base.

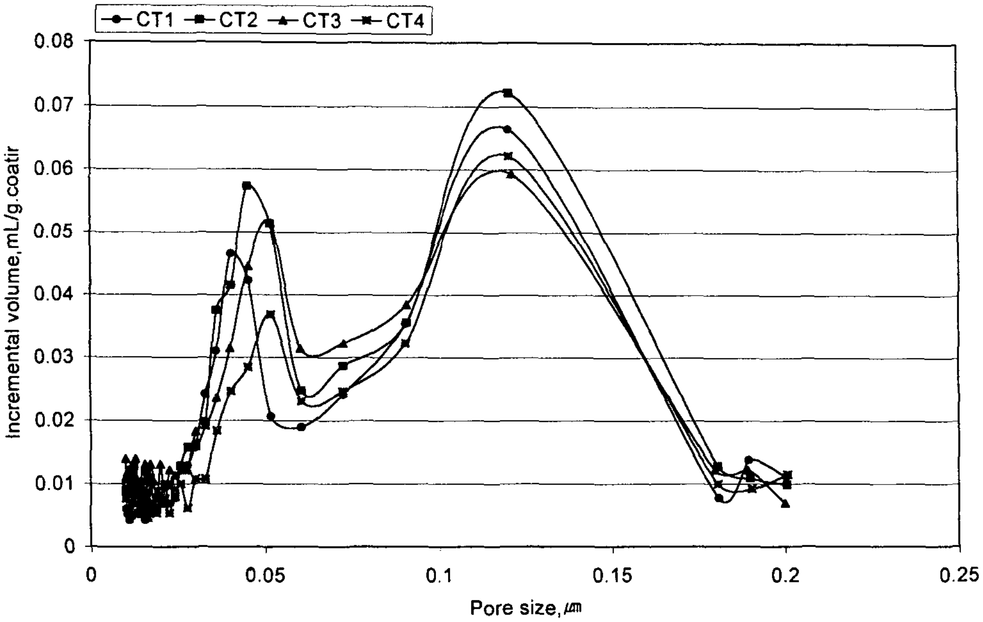


Fig.12 Pore size distribution, clay base

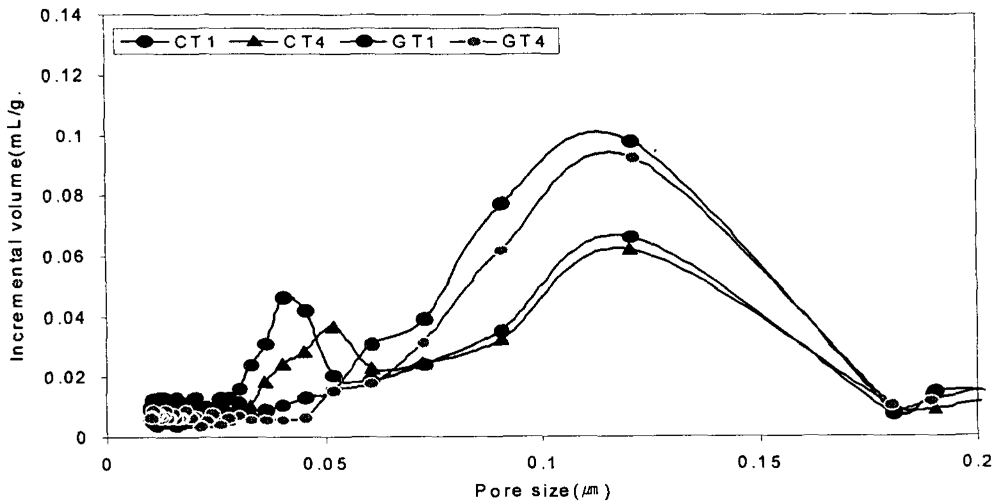


Fig.13. Pore size distribution, summary of two pigments base.

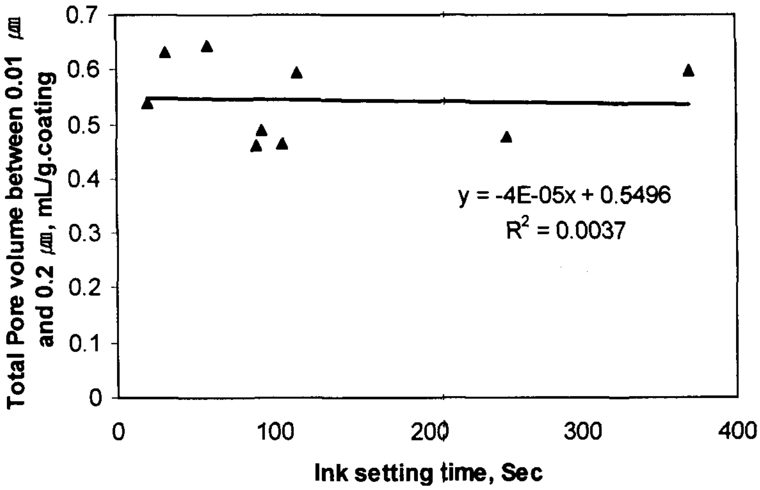


Fig.14. Pore volume vs. ink setting time

CONCLUSIONS

- Ink setting time was shorter for clay base coated paper than calcium carbonate base coating with same binder level, due to small pores in clay base coating.
- Calcium carbonate base coating increases its ink density after one pass test but clay decreased because of micro-picking.
- There was no correlation between pore volume of coating and ink setting time. But it was shown that small pore size distribution in coating affects to ink setting.
- A good correlation with delta ink density and ink setting time was found in the calcium carbonate base coating.