Factors Influencing the Surface Strength of Coated Papers

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Objectives

- To evaluate the effect of different coating color parameters on the surface strength of double coated papers in sheet-fed offset (SFO) printing

- To correlate lab test data with observed edge picking during commercial SFO printing trials
Background

- Latex binder is considered one of the most expensive coating components
- Continuous fine tuning of the binder level is important to cost reduction efforts – requires total systems approach
- One opportunity is to take advantage of the lower binder demand and higher solids potential of GCC
- However, the high tack inks used in SFO printing demand adequate surface strength
- Thus, a balancing act exists between optimizing coating costs and maintaining adequate coating surface strength
What is Edge Picking?

- Occurs in SFO where high-tack inks are used
- Coating is pulled out at the edge between printed and non-printed areas
- Adversely impacts print quality and leads to more frequent washing
- Excessive edge picking can damage the rubber blankets
- Thus, adequate surface strength is very important
Theoretical Considerations

- Tack development of inks through press influenced by ink setting characteristics of coated surface

- Ink setting impacted by pigments and latex
  - Fine pigments create many small pores, leading to
    - Higher capillary pressure and faster ink setting
  - Latex impact via
    - Chemistry of polymer
    - Effect on pore structure of coating layer

- Choice of pigments and binders (type and amount) will greatly affect ink/coating interaction and, thus, surface strength
Specially Designed Printing Method

- Used redesigned printing plate and higher tack inks to exacerbate (enhance) edge picking.

- This method also involved evaluating edge picking by
  - Visual examination of prints
  - Assessment of rubber blankets
  - Ranking edge picking between 0 (worst) and 100 (best)
Redesigned Print Test Form

- Short bars in 6 colors
- 6th unit: blue
- Short bars in 5 colors
- Headlines
- Different screens in black
- 1st unit: open area on rubber blanket
Evaluated Parameters

Pilot coater

- Solids content of coating color
- Pigment type
  GCC vs. high glossing clay
- Pigment fineness
  GCCs
- Pigment psd
  GCC: NPSD vs. BPSD
- Latex level
  high strength SB
- Calendering

Sheetfed offset press

- Man Roland R706 Press
- Color sequence – KCMYCGBlue
- Speed – 8000 iph
- High tack – 9.5 to 10.8
- High tack – 1st four units
- Standard tack – 7.5 to 10.0
- Standard tack – last 2 units
- Varnish unit – pressure only
## Pilot Coater Trial Program

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- Base paper: blade precoated 78 gsm
- Precoat – 100 GCC + starch/latex
- Topcoat viscosity – 1000 mPas
- Jet application, stiff blade 12 gsm per side of topcoat
- Supered to 75 gloss target
Lab Paper Testing

- Ink set-off  IGT – optical density – in Switzerland
- Ink set-off  RI Test – visual assessment – in Korea
- Paper and Ink Stability Test  NPA in US
- Dry and wet pick  Prüfbau in Switzerland and US
- Print gloss  Prüfbau in Switzerland and US
- Hg intrusion porosimetry & paper opticals  Switzerland
Ranking According to the Degree of Edge Picking

Press adjusted so that reference was about 50 on the scale

Degree of edge picking (0 = worst / 100 = best)
P&I Slopes

The lower the better

... % Solids

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100 parts GCC 95

5 % Latex

100 parts GCC 95

50/50 Clay GCC 95

7.5 % Latex

100 Clay high glossing

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100 GCC NSPD

7.5 % Latex

100 GCC 60

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100 GCC 90
P&I Passes to Failure

The higher the better

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Print Gloss
commercial printed papers

Lab print gloss and paper gloss results followed the same trend

% (FS/WS; 75° Tappi)

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RI Test Ink Setting vs. Edge Picking

Ink setting (6 = fastest / 0 = slowest)

Edge pick print press (100 = best / 0 = worst)

$R^2 = 0.8091$
IGT Ink Setting vs. Edge Picking

![Graph showing the relationship between Optical density and Edge pick print press. The graph has a linear trend line with R² = 0.8068.](image)

**Edge pick print press (100 = best / 0 = worst)**
P&I Ink Tack Slope vs. Edge Picking

The lower the better

Passes to fail had a similarly good correlation ($R^2 = 0.7733$)

$R^2 = 0.7414$

Edge pick print press (100 = best / 0 = worst)
Wet Pick vs. Edge Picking

- **m/s** (the higher the better)

Dry pick results had poor correlation as well ($R^2 = 0.4748$)

$R^2 = 0.4574$

**Edge pick print press** (100 = best / 0 = worst)
Uncalendered results showed slightly larger pore size.
Conclusions (I)

- Specially designed commercial SFO printing method provided differentiation regarding edge picking.

- Good correlation found between degree of edge picking and lab ink setting/tack measurements. Thus, quantifying ink/coating interaction as a function of time best "lab scale simulation" of surface strength.

- Hg intrusion porosimetry data indicated that coating pore structure mainly depends on pigment fineness.

- Calendering offered an improvement in surface strength.
Conclusions (II)

- Ink setting and ink tack results indicate that pore structure of coating layer is crucial to degree of pick strength.

- Slower ink setting favors higher surface strength via:
  - Pigments – GCC vs. clay and coarse vs. fine
  - Higher solids
  - Higher latex amount

- Lower surface strength of clay coatings due to:
  - Faster ink setting (from finer pore size)
  - Higher specific surface area (higher binder demand)
  - Hydrophobic nature of clay
Conclusions (III)

- NPSD GCC had better surface strength than expected

- Choice of pigments along with maximizing coating solids
  - Allowed for reduction in binder level w/o compromising surface strength
  - Improved sheet and print gloss

- Future work to assess further the impact of coarser clays and coating PCC
Thank You for Your Attention!