Surface Topography Contribution to Coated Board Surface before and after Calendering

A correlation study: Verity IA Topography, Emveco Profilometer, and Parker Print Surf

Mario A. Cruz
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Paper Presented by: Roy Rosenberger
Foreword

The correlation data presented in this paper were obtained as part of a wider study of RFID print on coated Solid Bleached Board which will be presented by Mario Cruz at the TAPPI Coating conference. The objectives of that study were to determine if the roughness of the substrate before coating influenced the resistivity of the RFID inks printed on the coated surface.
Overview

- Project
  SBS Board
  Coating
- Methodology
- Results
- Conclusions
- Acknowledgement
Project

Objectives:
Understand the effect of substrate topography on subsequent coating and calendering.

To perform a comparative study of a new Verity IA Topography measurement device to other surface topography devices.
Project cont…

- **Substrate**: Solid Bleached Sulfate board (SBS)
- **Coating**: Commercial Formulation (Clay, Calcium Carbonate, etc….)
Solid Bleached Sulfate Board (SBS)

- High quality board
- Used in high quality packaging, such as perfume boxes.
- Requirements: Brightness, gloss and good surface properties, that allow high quality printing.
Coating

- Commercial formulation:

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>PPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrawhite 90 (Clay)</td>
<td>50</td>
</tr>
<tr>
<td>Hydrocarb 90 (Calcium Carbonate)</td>
<td>50</td>
</tr>
<tr>
<td>Dow PB6620 (Binder)</td>
<td>16</td>
</tr>
<tr>
<td>Alco Gum (Thickener)</td>
<td>0.05</td>
</tr>
<tr>
<td>Dispex (Dispersant)</td>
<td>0.25</td>
</tr>
</tbody>
</table>
Coating cont...

- Ultrawhite 90: Optimize brightness, opacity and coverage in paper and board.

- Hydrocarb 90: Provides high brightness, reduces binder demand.

- Dow PB6620: Binder

- Dispex: Dispersant used for calcium carbonate and TiO$_2$. 
Blade Coaters

Used in high quality printing and packaging papers and boards. It provides the smoothest and most uniform coated surface.
Air Knife

Jet of air is used to meter the amount of coating of the substrate

Commonly used in high coat weight boards
Coating & Calendering

<table>
<thead>
<tr>
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<th>Air Knife</th>
<th>Blade</th>
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<tr>
<td>Coat Weight (gr/m²)</td>
<td>Calendering (pli)</td>
<td>Coat Weight (gr/m²)</td>
</tr>
<tr>
<td>10.86</td>
<td>600</td>
<td>9.61</td>
</tr>
<tr>
<td>14.42</td>
<td>1200</td>
<td>13.87</td>
</tr>
<tr>
<td>23.92</td>
<td>UnCal</td>
<td>22.54</td>
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</table>
Topography Devices

- Emveco Stylus Profilometer
- Verity IA Topography system
- Parker Print Surf (PPS)
Emveco Stylus Profilometer

- Model 210
- Cone shaped stylus
- Stylus Radius of 25 \( \mu m \)
- 500 readings per sample
- 0.1 mm reading space
Verity-Topo®

- Topography Software is used to numerically rank the surface topography

- Special Modified Verity IA Scanner with Verity IA Specimen Weight and standard PC

- Area scanned 8” x 8” at Resolution of 600 ppi
Parker Print Surf (PPS)

- PPS is designed to measure the surface roughness of sheet materials under conditions similar to those during printing process.

- The sample is clamped between a head and a specifically designed backing.

- Clamping pressure 1000 kPa

- Area: 10 cm²
Methodology

- Analysis
  - Topography (Verity-Topo)
  - Roughness (Emveco Profilometer)
  - Roughness (PPS)
  - Porosity (PPS)
  - Thickness

4 Topography conditions
30 samples at each condition
9 measurement points for each sample
Total = 1080 measurements
Methodology

- Characterize Uncoated SBS Board
  - Topography Roughness (2)
  - Porosity

- Apply Coating With: Air Knife & Blade
  - Coat Weight: High, Medium, Low

- Re-characterize
  - Topography Roughness (2)

- Calendering
  - Pressure / Linear Inch (PLI): 600, 1200

- Re-Characterize
  - Topography Roughness (2)
Substrate Analysis

SBS Roll - 300 Meters

Topography Condition 1: 30 Samples
Topography Condition 2: 30 Samples

30 samples for each Topography condition

67.3 M (225 ft)

30 samples for each Topography condition
Substrate Analysis  cont…

200 mm (8”)

• Verity IA Topography
• Emveco Roughness
• PPS Roughness
• Thickness

9 measurement at different points
Substrate Analysis cont...
Substrate Analysis cont...
Uncoated Substrate Results

- Emvec Roughness (microns): Average 4.89
  - StDev 0.28
- PPS Roughness (microns) Average 5.01
  - StDev 0.15
- Verity IA Topo Average 3.49
  - StDev 0.21
- Thickness 355 µm
- PPS Porosity Average 271.4 ml/min
  - StDev 19.4
Methodology

Characterize Uncoated SBS Board

Apply Coating With: Air Knife & Blade

Re-characterize

Topography Roughness (2)
Porosity

Coat Weight:
- High
- Medium
- Low

Pressure / Linear Inch (PLI)
- 600
- 1200

Re-characterize

Topography Roughness (2)

Topography Roughness (2)
## Coating & Calendering

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Topography Results
High Coat Weight

Conditions
1. Uncoated   2. Uncalendered

Verity  Emveco  PPS
Topography Results
Medium Coat Weight

Topography
Medium Coat Weight Air Knife

Conditions
1. Uncoated
2. Uncalendered
3. Calendered 600 pli
4. Calendered 1200 pli

- Verity
- Emveco
- PPS
Topography Results
Low Coat Weight

Topography Air knife Low Coat Weight

Conditions
1. Uncoated  2. Uncalendered

Verity  Emveco  PPS
Correlation
PPS Vs. Verity

Correlation PPS Vs. Verity

$y = 0.4372x - 0.1402$

$R^2 = 0.7479$
Correlation

Correlation Emveco Vs. Verity

\[ y = 1.0871x - 0.8609 \]

\[ R^2 = 0.8703 \]
Verity-Topo® Surface Display Image - SBS Before Coating
Conclusions

- Decreased coat weight caused a decrease in the topography number.

- Blade samples showed a better topography than Air knife.

- All instruments evaluated were able to predict coating topography with measurement of the substrate.
Conclusions

- Emveco Stylus Profilometer correlates better with the Verity. A better correlation was obtained than the one with Parker Print Surf and Verity.

- The visual image display obtained with the Verity Software is a big plus in the selection of a topography measuring device. Also, the measured area is more representative in comparison with the other two instruments.
Thank you !!!

Questions…