



# Paper Parameters That Affect Color Reproduction

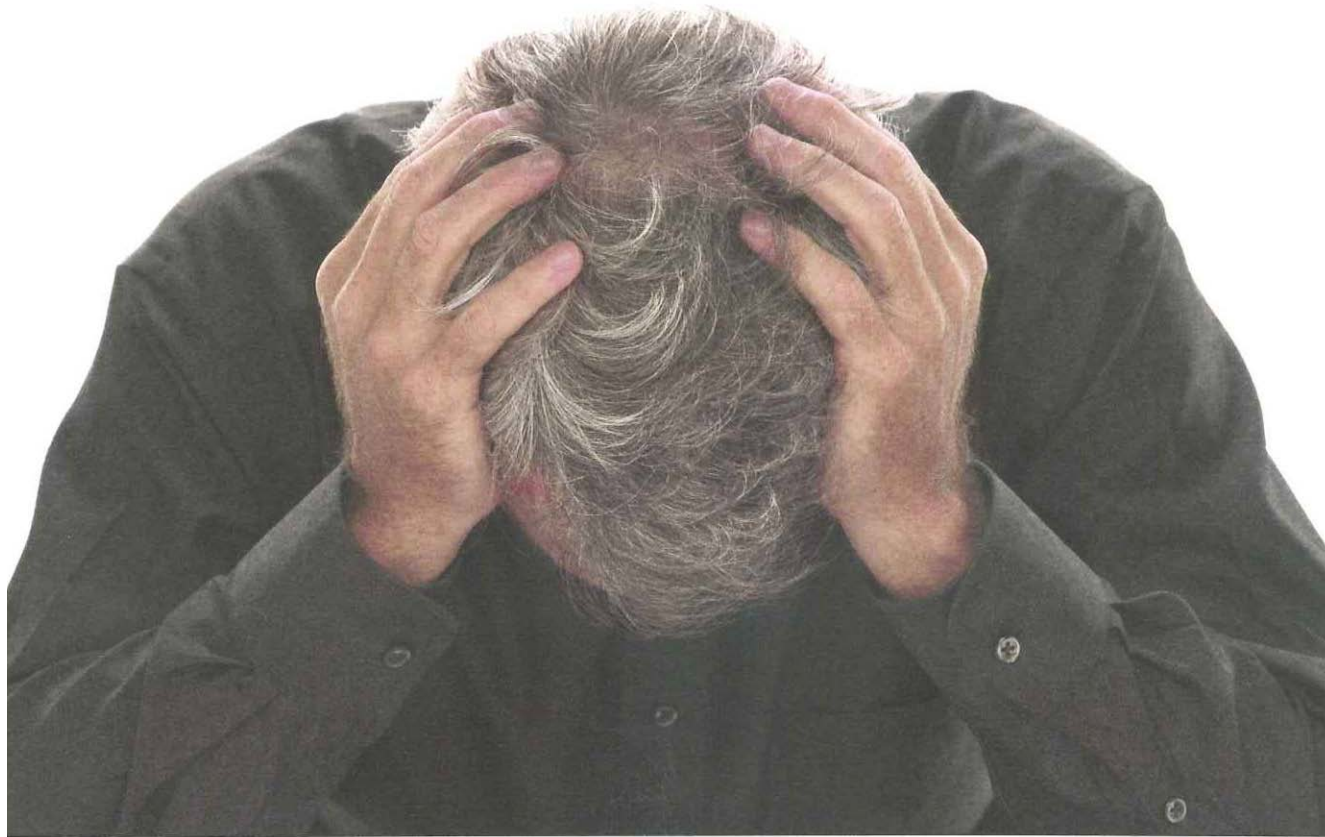
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Sun Chemical

Color Research Laboratory



Why does my profile not  
match my customer's profile?





# “Types of Paper”

- Paper Type is not a quality indicator or grade in paper classification.
- New raw materials are changing the meanings of some performance parameters.
- Paper type was devised by the National Recovery Act (NRA) in the 1930s
  - Today it relates primarily to the Brightness of a paper and thus to the price of the paper.

# Paper Tests

- There are many tests applied to papers.
- Many tests are related to end use or printability.
- In addition to paper appearance – several parameters impact the appearance.
  - Ink gloss
  - Ink holdout
  - Coating content
  - Paper smoothness
  - Refining & Calendering

APPLICATIONS FOR PAPER TESTING							
PROPERTY TESTED	USEFUL FOR:						
	APPEARANCE	RUNNABILITY	PRINTABILITY/ PRINT QUALITY	END USE			
<b>APPEARANCE</b>							
Color/Shade					•		•
Opacity					•		•
Gloss					•		•
Brightness					•		•
<b>RUNNABILITY</b>							
Caliper							•
Stiffness							•
Porosity					•		•
Slipperiness							•
Curl	•						•
Moisture Content					•		•
Relative Humidity					•		•
Hygroexpansivity					•		•
Tensile Strength/Stretch					•		•
<b>PRINTABILITY/PRINT QUALITY</b>							
Smoothness	•		•				•
Surface Strength			•				•
Ink Receptivity							•
Plybond			•				•
Blistering			•				•
Letterpress Printability							•
Gravure Printability							•
Offset Printability							•
Printed Ink Gloss	•						•
Ink/Water Penetration			•				•
<b>END USE</b>							
Basis Weight			•		•		
Bulk			•				
Folding Strength			•				
Folding Quality							
Tearing Strength			•				
Carbonizing							
Bursting Strength							

# Gloss: ISO 8254

## Paper Gloss

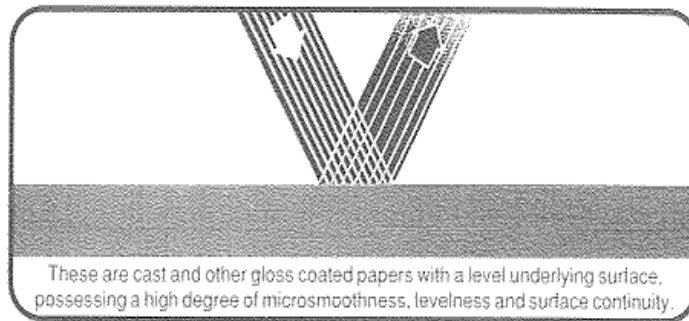


Figure 3.6 - High Gloss Papers

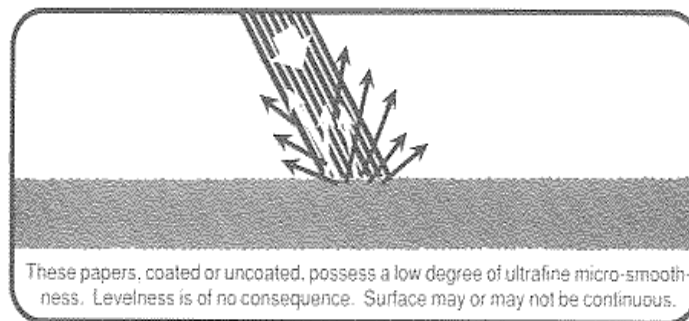
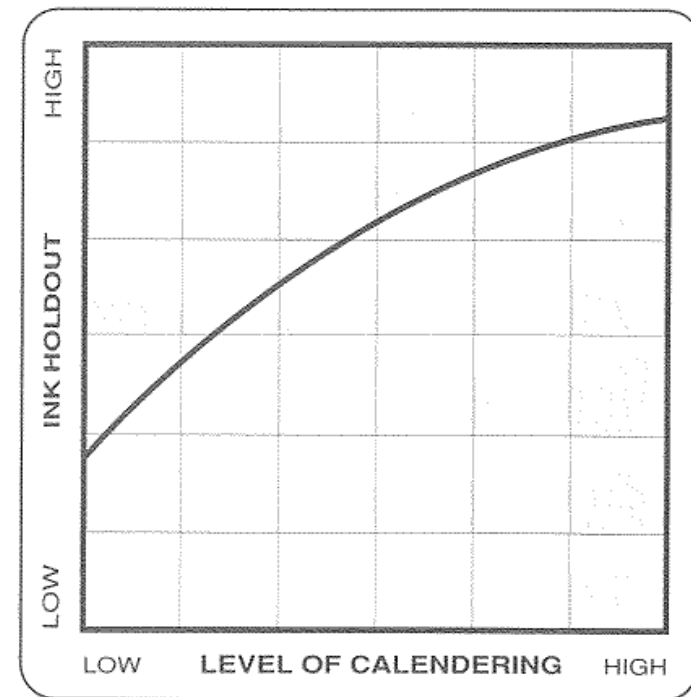


Figure 3.7 - Low Gloss Papers

## Ink Gloss





# What is Happening to Publication Paper?

## A dramatic difference you'll notice right away.

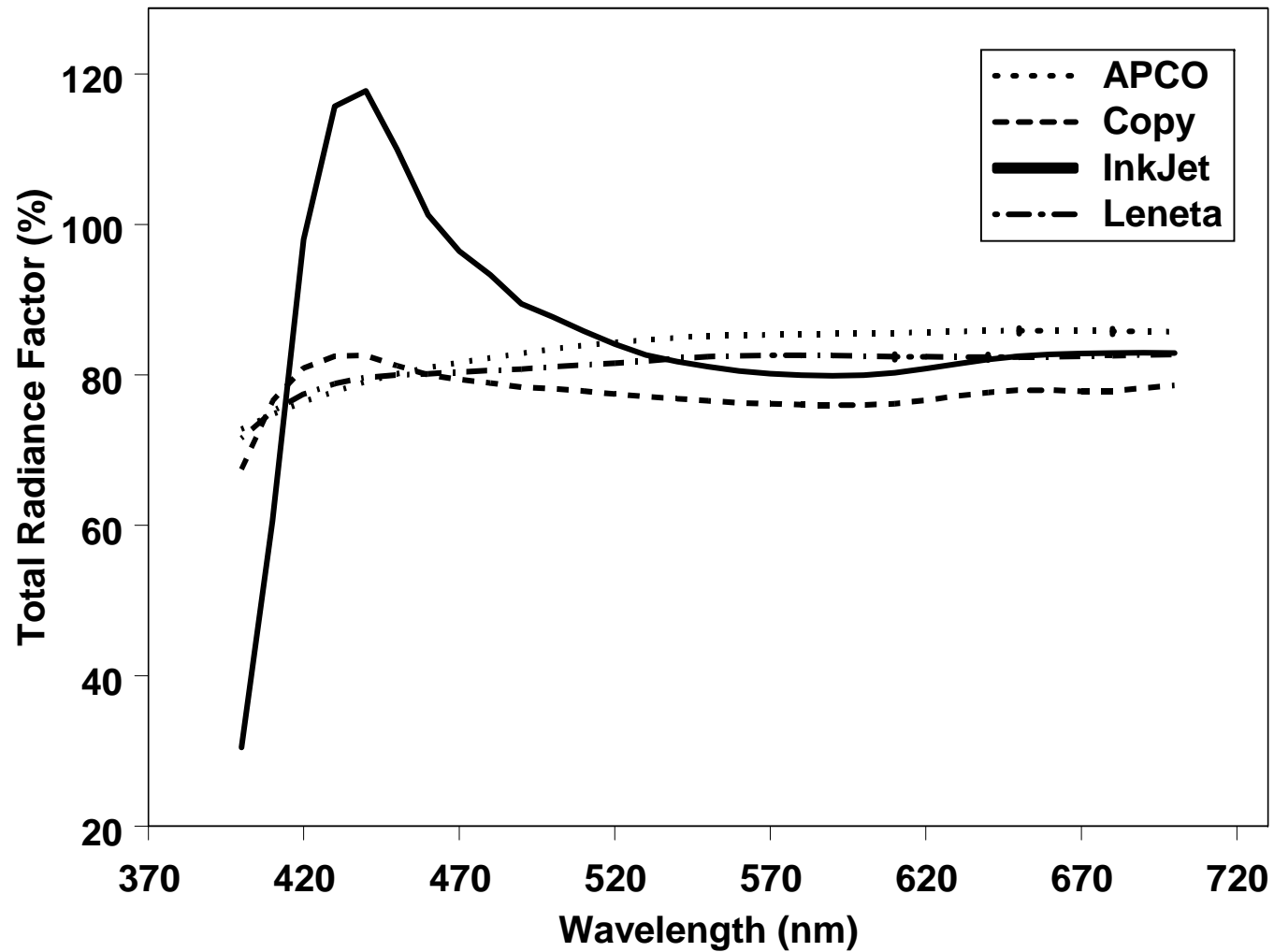
Significantly whiter and brighter than before, your favorite IP papers now outshine other papers in their categories, providing greater print contrast and more vibrant color. Look at the increases we've made across the board.

	Old W/B	New W/B
Accent® Opaque	139/92	<b>152/96</b>
Williamsburg	97/84	<b>145/92</b>
Hammermill Tidal® MP	95/84	<b>145/92</b>
Hammermill Fore® MP	145/92	<b>153/96</b>
Great White® Copy	95/84	<b>145/92</b>

*The CIE (Commission Internationale de l'Eclairage—International Commission on Illumination) method is the most frequently used for measuring paper whiteness.*

What is the difference between CIE Whiteness and Brightness?

# Reflectance & Fluorescence



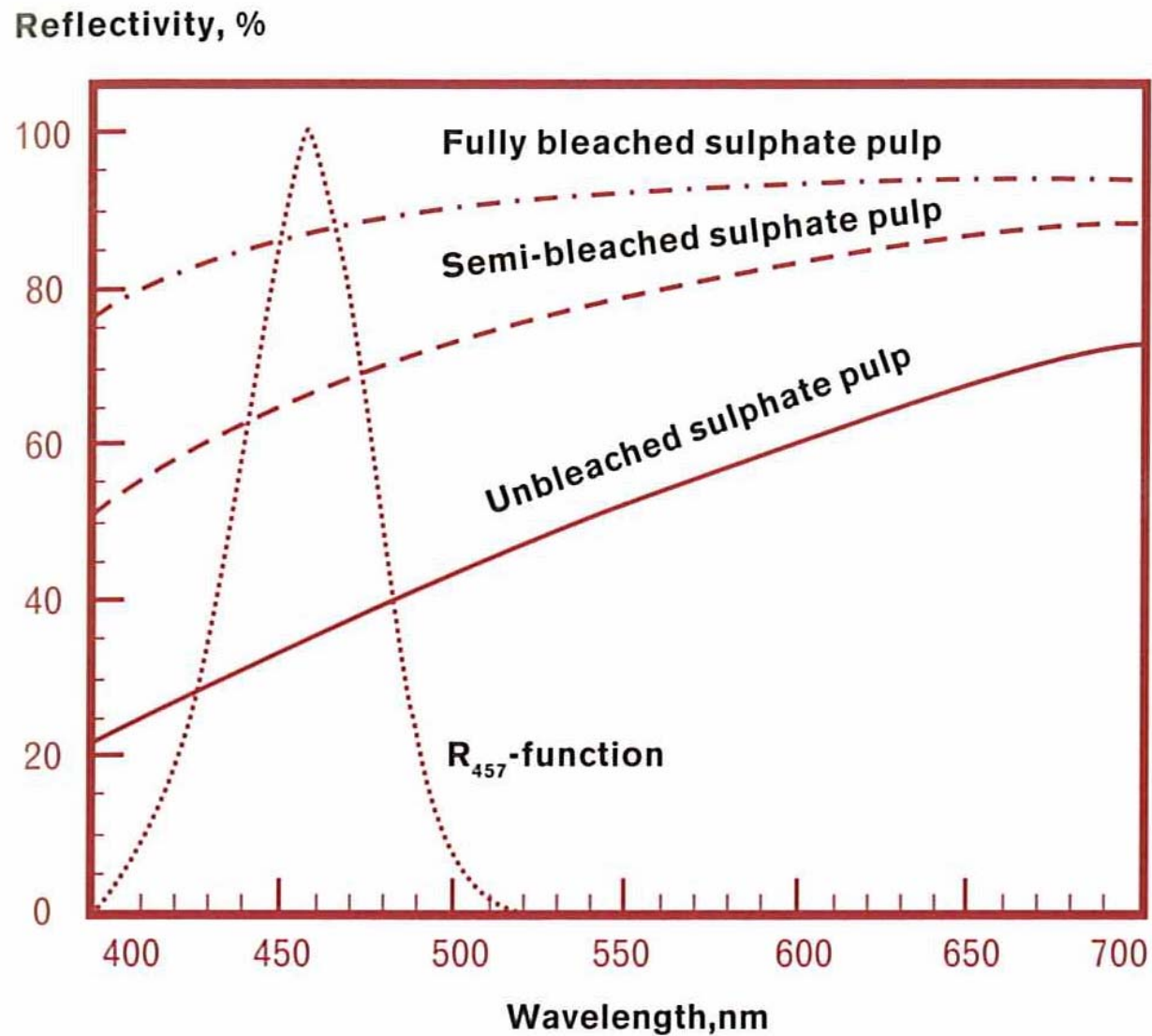


# ISO Whiteness & Brightness

- Brightness is the intrinsic reflectance factor measured with a reflectometer having the characteristics described in ISO 2469, equipped with a filter or corresponding function having an effective wavelength of 457 nm and a width at half height of 44 nm, and adjusted so that UV content of the illumination incident upon the test piece corresponds to that of CIE illuminant C.
- CIE whiteness is a measure of whiteness derived from CIE tristimulus values determined under the conditions specified in this International Standard and expressed as whiteness units.
  - $W = Y + W_x (x_n - x) + W_y (y_n - y)$
  - $W_x = 800, W_y = 1700, x_n = 0.3138, y_n = 0.3310$  for CIE D65/10°



# ISO Brightness





# Effect of FWA on Color Readings

Measured CIELAB Color Differences (UVX-UVI)  
for ink-jet paper and an ink jet printer

Halftone (%)	Cyan	Magenta	Yellow	Black
5	12.15	12.30	12.05	11.20
10	11.87	12.10	11.41	9.69
15	11.55	11.82	10.86	8.35
20	11.14	11.63	10.37	6.85
30	10.59	10.82	9.22	4.36
40	9.73	10.03	7.73	4.05
55	8.02	8.41	5.74	5.96
75	6.18	6.20	3.49	4.77
100	4.84	4.64	3.08	0.64

# Extenders in Papers

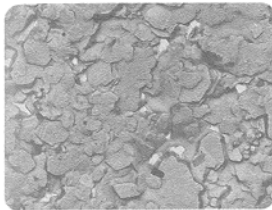


Figure 2.4 - Fine Clay

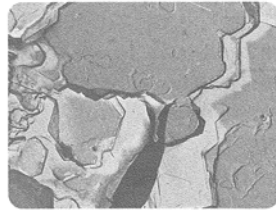


Figure 2.5 - Coarse Clay

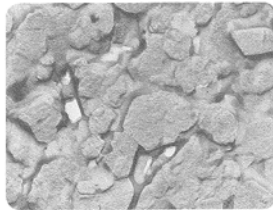


Figure 2.6 - Delaminated Clay

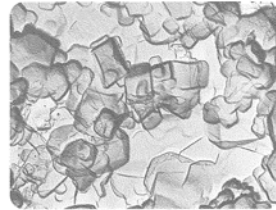


Figure 2.7 - Calcium Carbonate

Figure 3.14 - The Effect of Basis Weight on Opacity

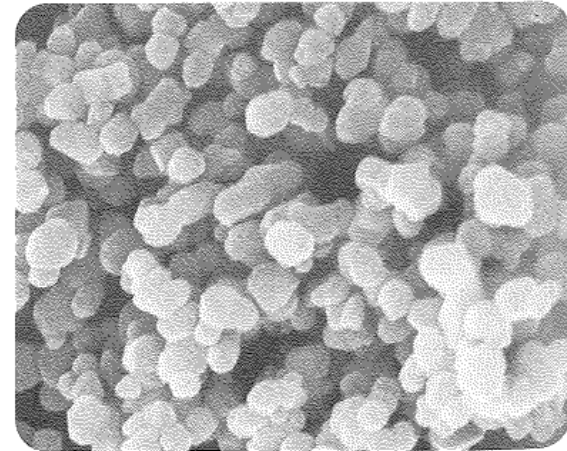


Fig. 2.10 - Titanium Dioxide Particles

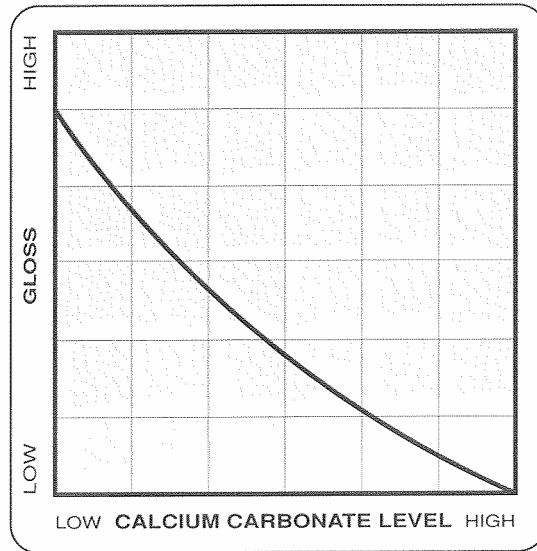


Figure 2.8 - Effect of Calcium Carbonate Level on Gloss

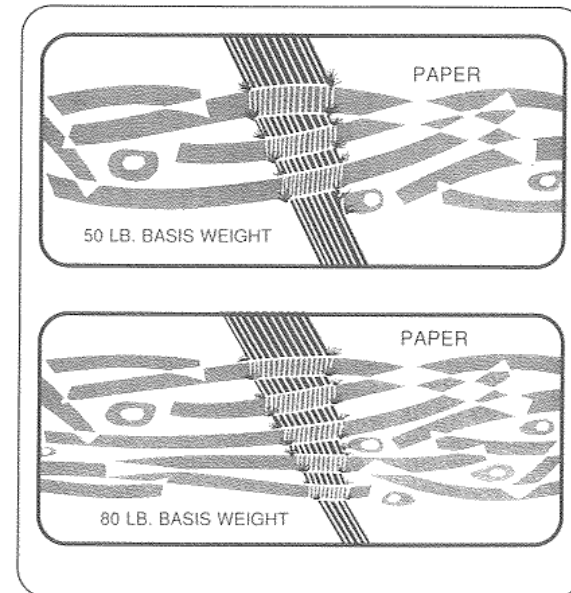


Figure 3.14 - The Effect of Basis Weight on Opacity



# Effect of Coating, Refining and Calendering

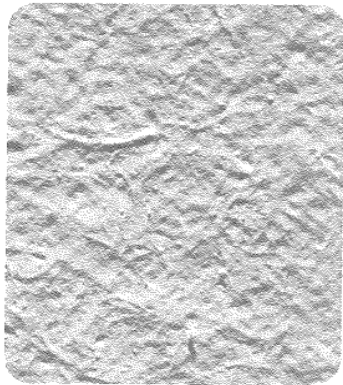


Figure 2.21  
Spread Shaft Coated Surface (25x)

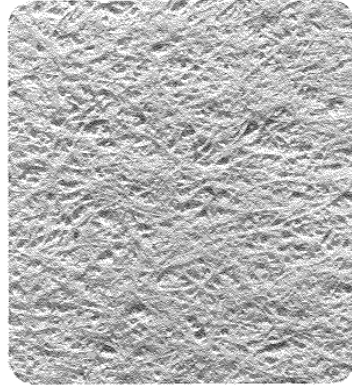


Fig. 2.18  
Pressure Coated Surface (25x)



Figure 2.31 - Basestock Before Coating (25x)

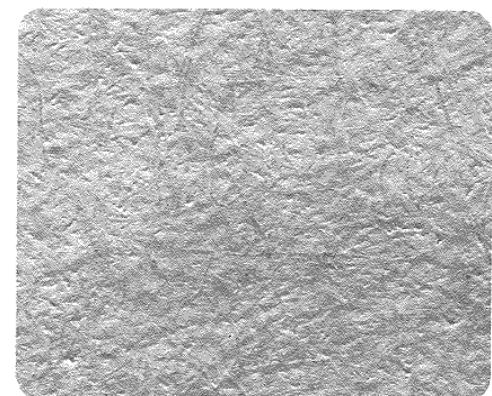


Fig. 2.32 - Blade Coated and Supercalendered (25x)

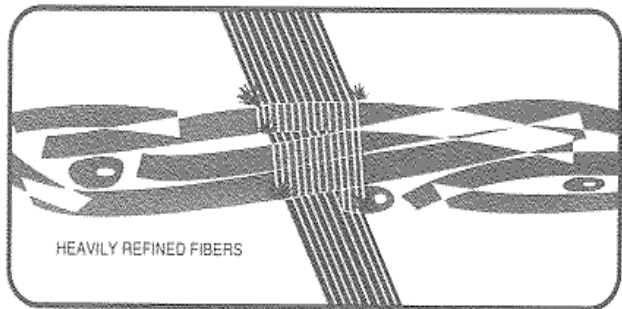


Figure 3.12 - Effect of Refining on Opacity



Figure 2.25  
Basestock (25x)

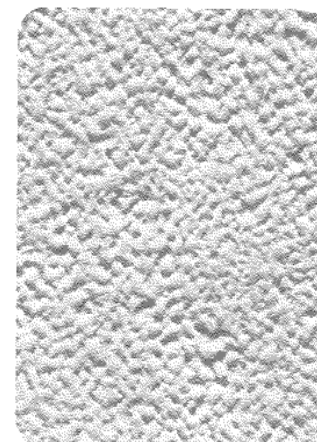


Figure 2.26  
Pronounced Pile Pattern (25x)

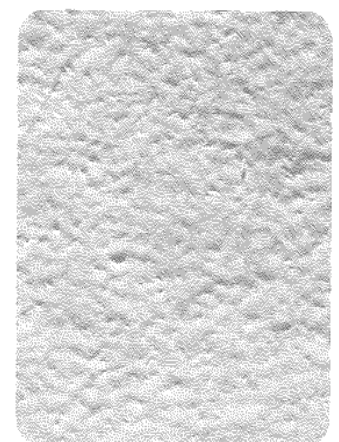


Figure 2.27  
Finished Supercalendered Paper (25x)

# Paper Smoothness

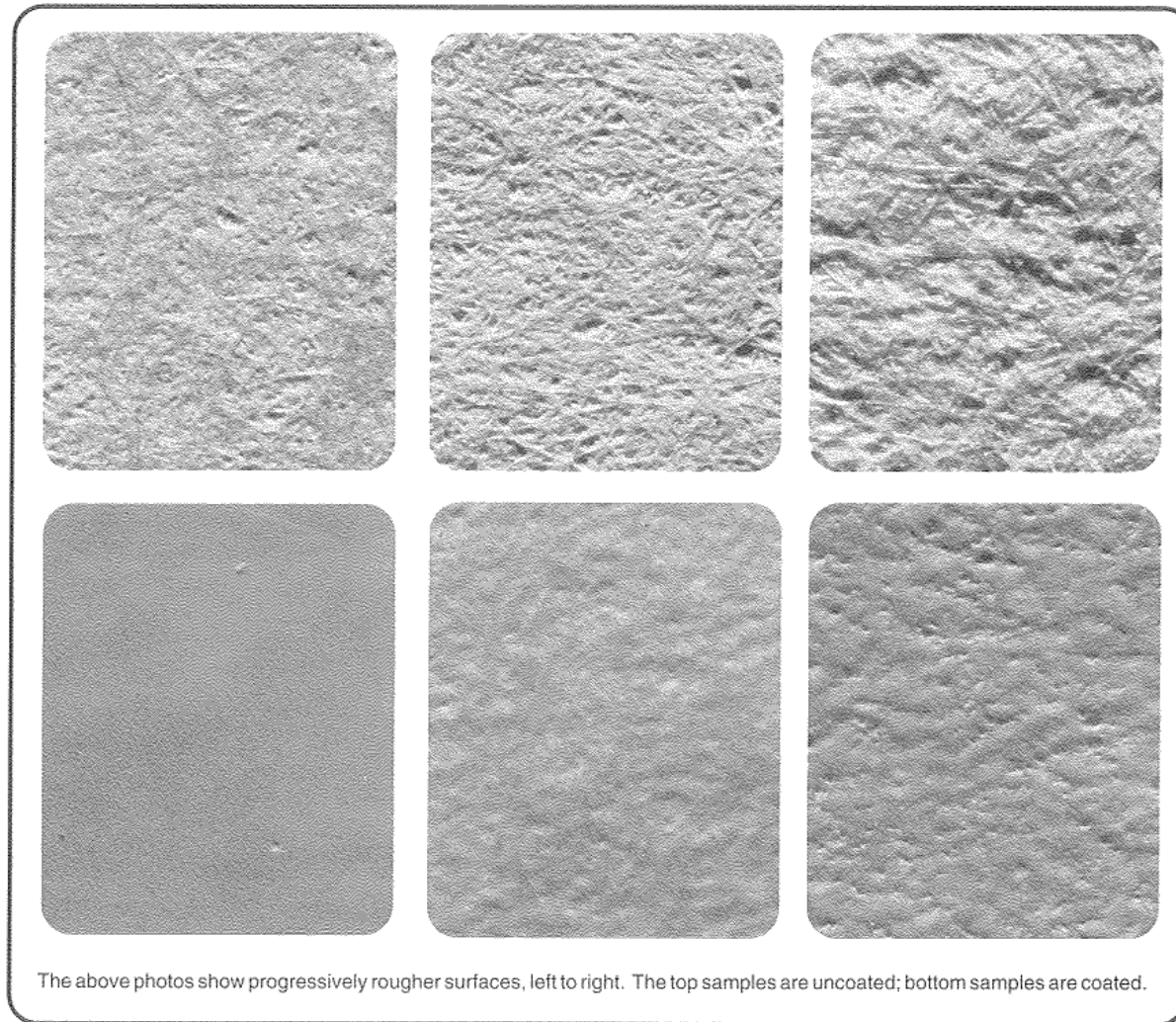


Figure 6.20 - Surface Photomicrographs (25x)



## 3D Surface Profilometer Display of Gravure Dots on Packaging Film



### 3-Dimensional Interactive Display

Date: 02/02/2004

Time: 10:15:06

#### Surface Stats:

Ra: 192.88 nm

Rq: 263.14 nm

Rt: 2.82 um

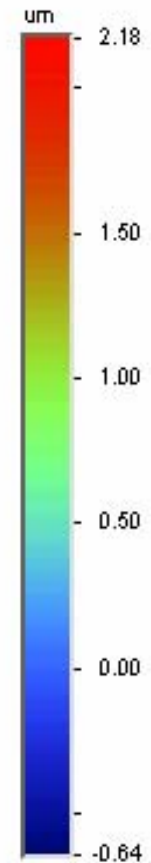
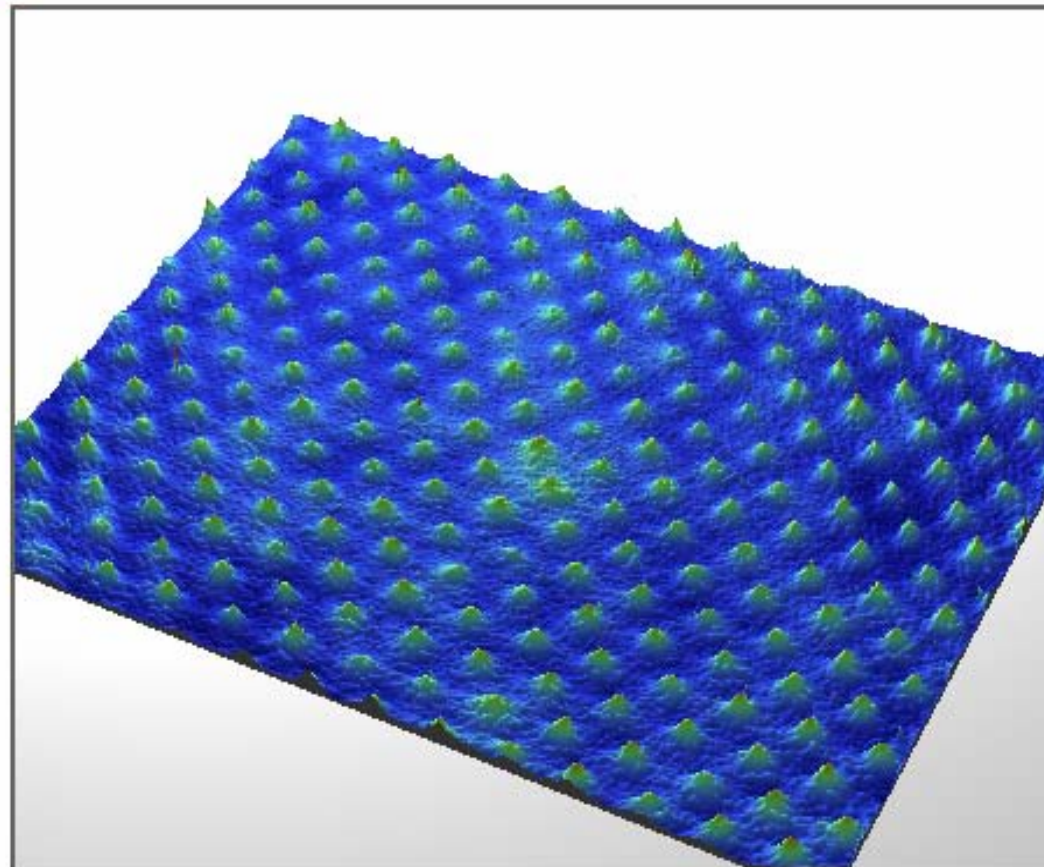
#### Measurement Info:

Magnification: 2.53

Measurement Mode: VSI

Sampling: 3.32 um

Array Size: 736 X 480

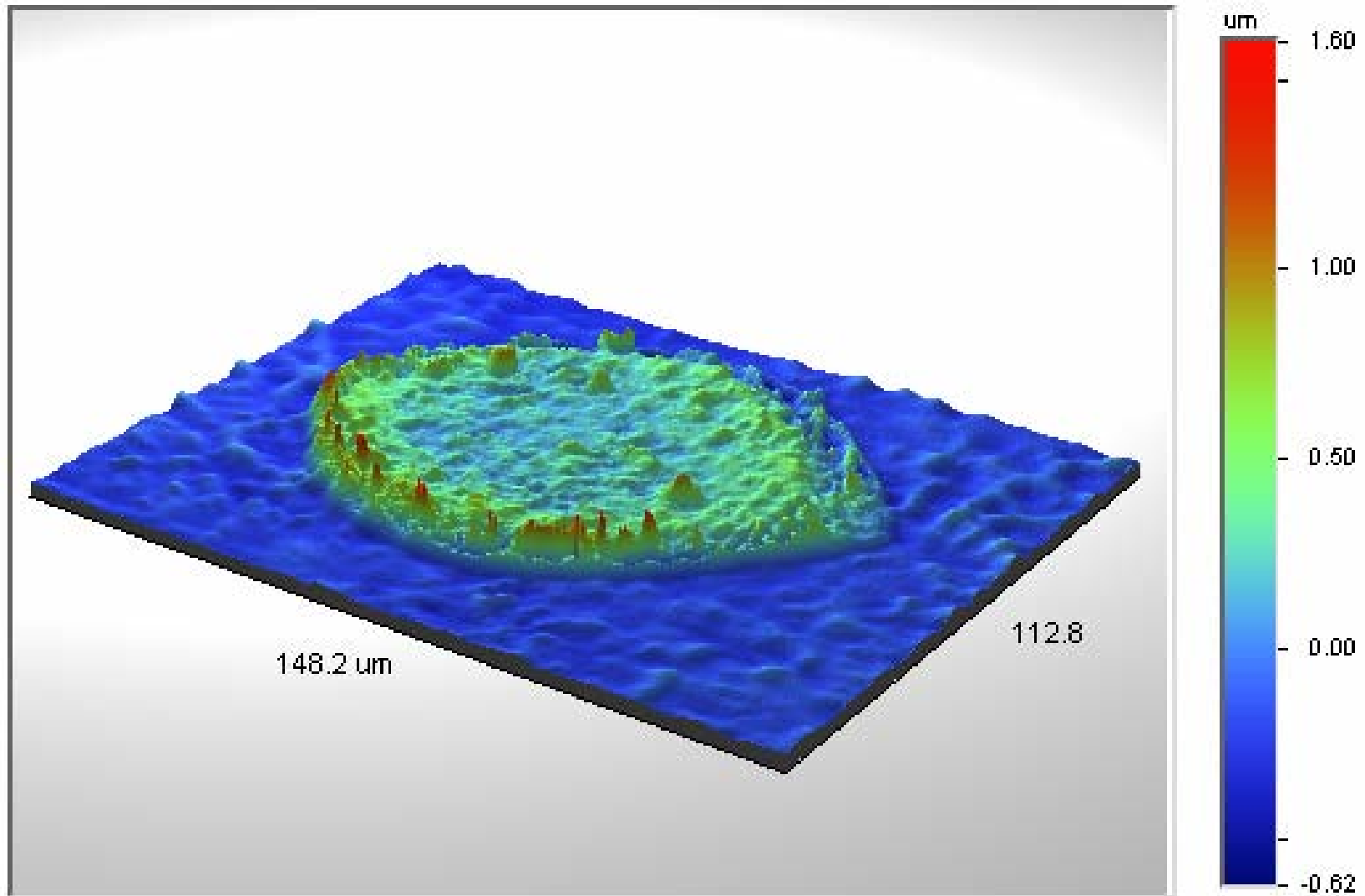


Title: 040085

Note: GP2 - blue/black trap 1

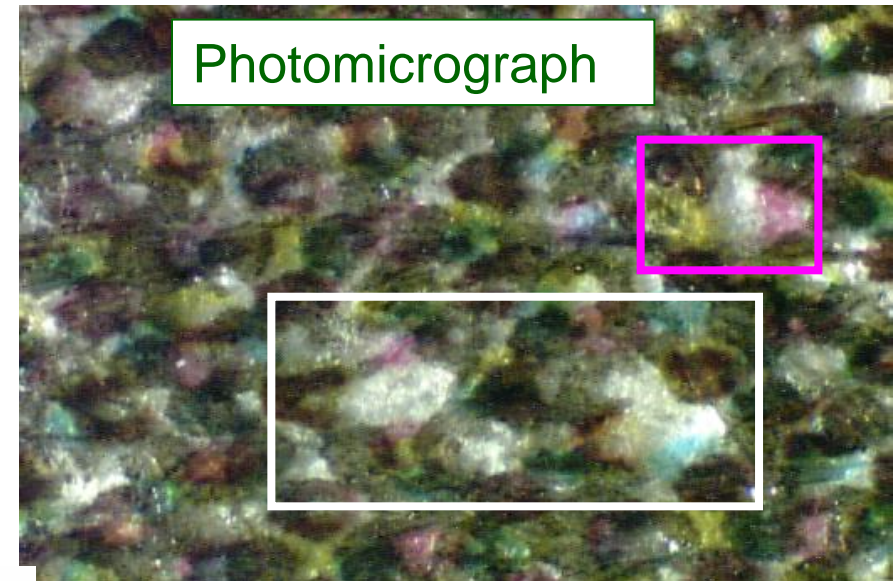
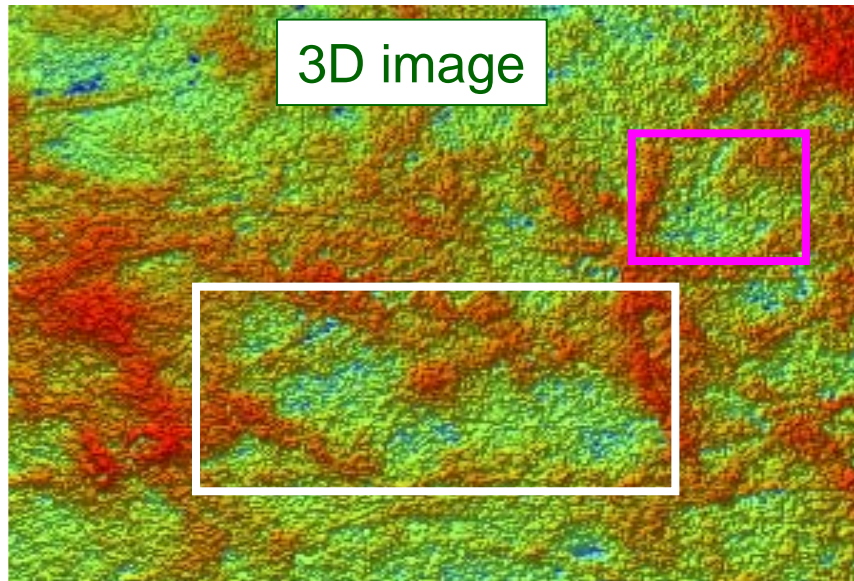
Gravure print - 3D image (angle view) of Polypropylene printed film

## Single Gravure Dot on Polypropylene Packaging Film



Gravure dot on PP film – 3D image (angle view)

## Optical Profilometer Images and Scans of Gravure Printing on Paper Substrate

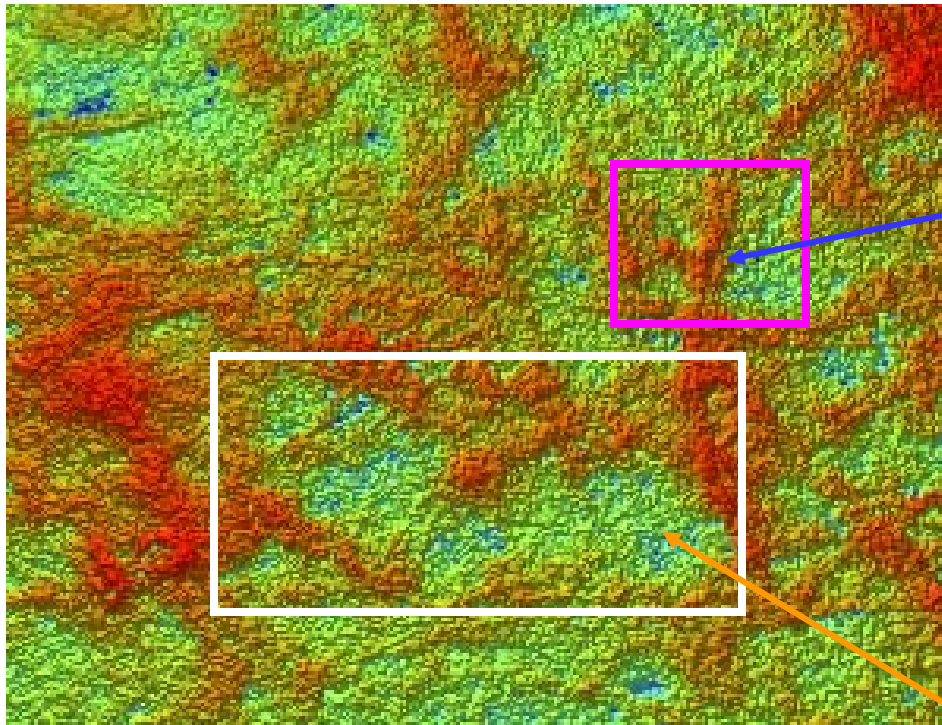


Rough and wavy surface of  
paper – **skipped dots**



Rough and flat surface of  
paper – no skipped dots

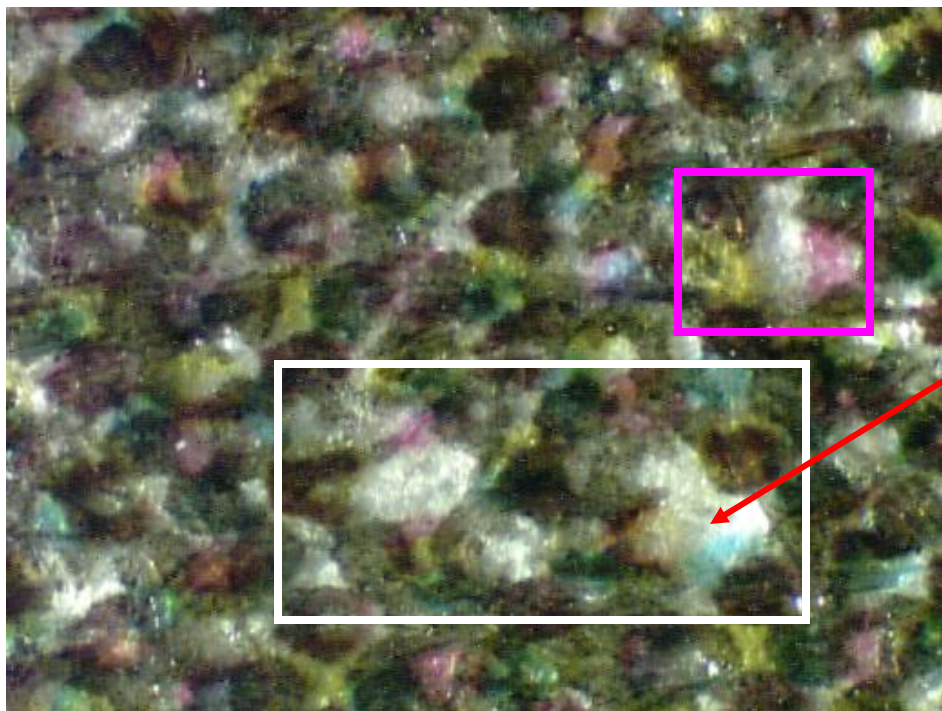




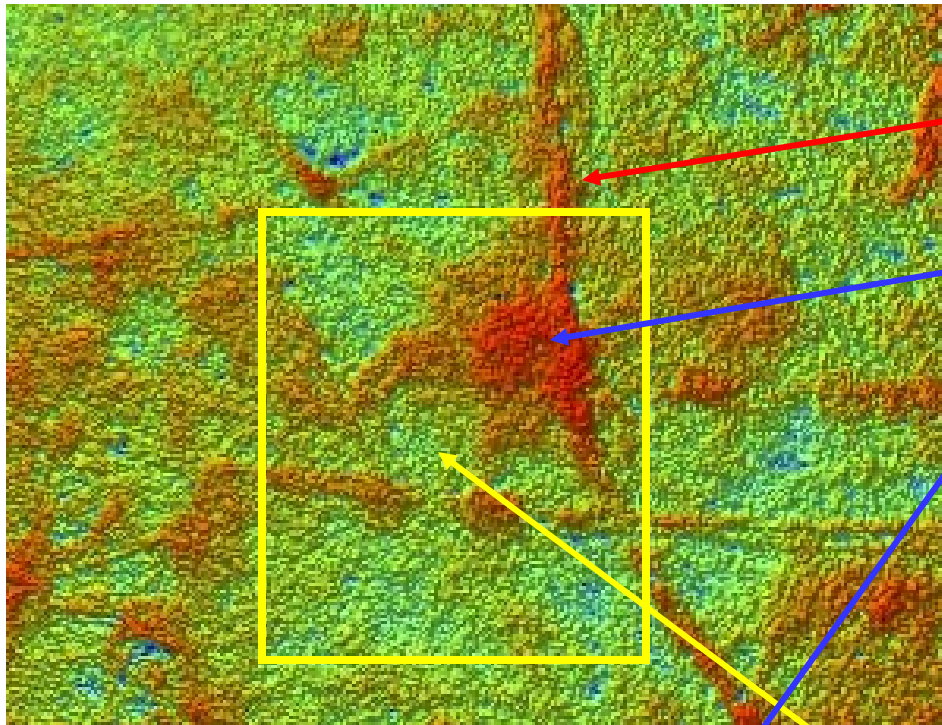
Cellulose fiber

Valley

Skipped dot



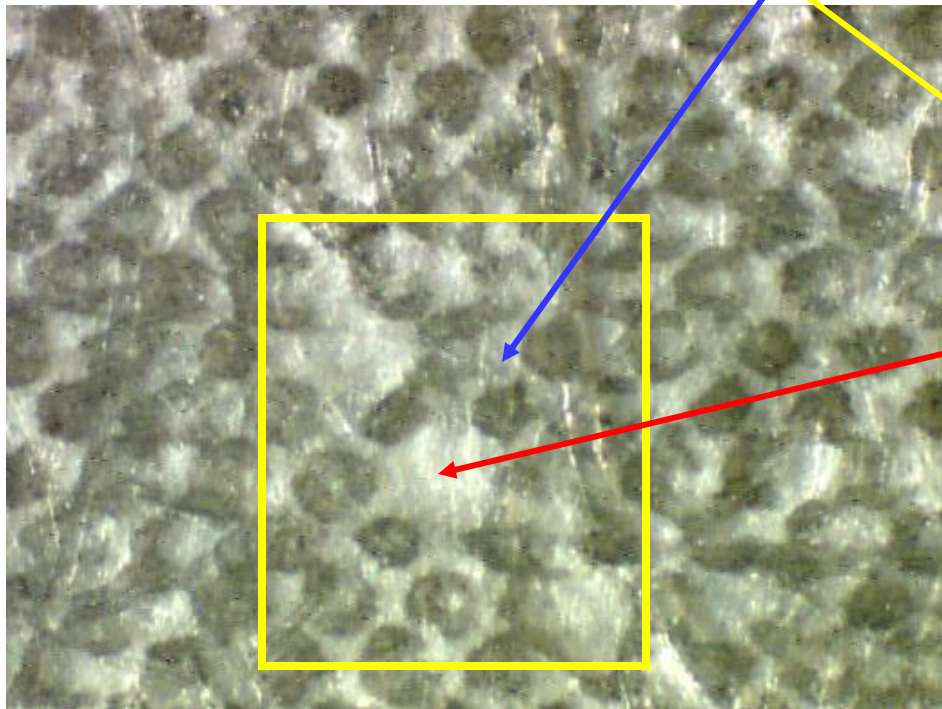
Photomicrograph and 3D image  
(top view) of the same area of  
gravure print on paper.



Protruding cellulose fiber

bump

Missing dots leads to a mottled appearance and inconsistent reflectance readings over small areas.



Valley

Skipped dot

Photomicrograph and 3D image (top view) of the same area of the gravure print on paper.



# Initiatives to Improve Predictability of Printing

- IDEAlliance has formed a Print Predictability Paper Taskforce
  - Part of Paper Supply Chain Committee
    - Develop, deploy, and adopt processes and methodologies for the content and print creator (i.e., art director, designer, and product manager) and buyer that supports and enables color management technologies to be used for print predictability across the supply chain.
  - Select and drive adoption of techniques, tools and methodologies enabling an advertiser, print creator or buyer, and printer to accurately evaluate print and proofing processes that reflect print predictability.
- Create a methodology, process or technique that is based on paper performance
  - The paper's ability to reproduce imagery so that paper purchasers can evaluate their choices based on both optical and physical factors.
  - Paper buyers, content creators and printers do not know how a paper will perform on press nor duplicate color prior to printing.
  - Current paper classification is based on Brightness.
    - Brightness does not correlate with critical performance properties.



# IGT Printability Tests

	Offset	Gravure	Flexo	Newsprint
Mottle	W-57 (1)	W-82 (2)	W-76	---
Print penetration	W-24	W-24 (3)	W-24 (4)	W-24
Set-off	W-48	---	---	W-48
Wet-pick/repellence	W-32	---	---	W-32
IGT Roughness	W-28	W-28	W-28	W-28
Print through	W-43	W-82	W-76	W-43
Gloss	W-49	W-82	W-76	W-49
Ink transfer	W-50	W-82	W-76	W-50
Picking	ISO 3783	ISO 3783	ISO 3783	W-44 (linting)

[illegible]



# The End

Thanks to:

W. deGroot – IGT

Nils Pauler – Paper Optics

Mead Paper