A New Paper Coating Nano-technology with Unique Characteristics to Improve Print Density

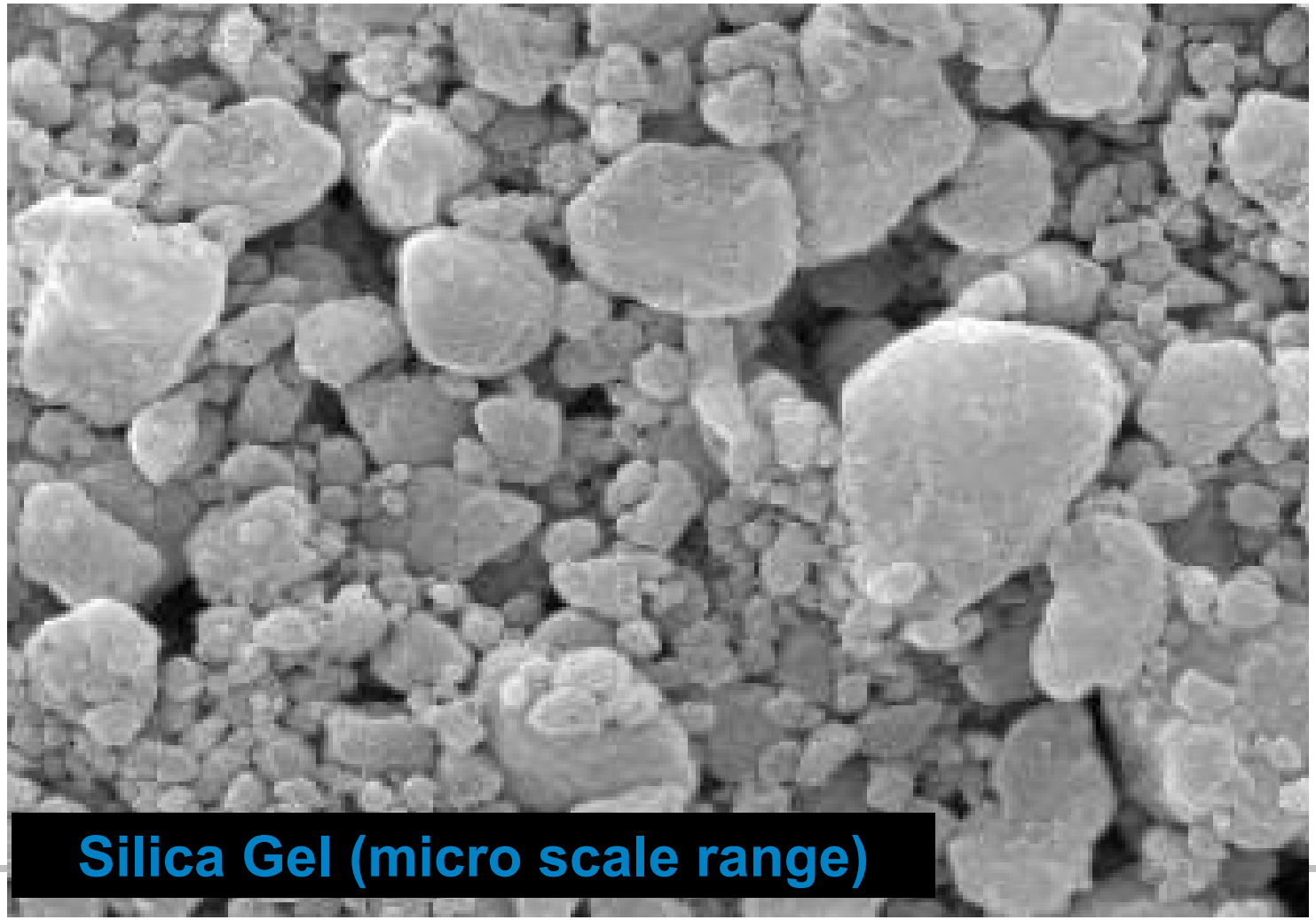
Dr. M. Patricia Wild – Eka Chemicals Inc, USA
Ylva Wildlock – Eka Chemicals AB, Sweden
Kjell Andersson – Eka Chemicals AB, Sweden
Erik Lindgren – Eka Chemicals AB, Sweden

Silica Inkjet Coating

Existing silica based coatings:

- Conventional technology for high quality inkjet printing papers
- Three main ingredients
  - Silica pigments (such as fumed, gel, colloidal)
  - Binder (PVOH, PVA)
  - Cationic polymer (PolyDADMAC)

Silica Particles



Silica Gel (micro scale range)

Binders

Existing Limitations

Limitations of Existing Silica Coatings:

- Low Solids (maximum 25%)
  - Requires intense drying
  - Needs slow coating speed, therefore, limits commercial application

Existing Limitations (cont.)

- **High binder requirements (>40 wt.%)**
  - Swellable vs. Capillary system
    - Slows down rate of ink absorption
      - Limits ink load
      - Decreases print density and gamut

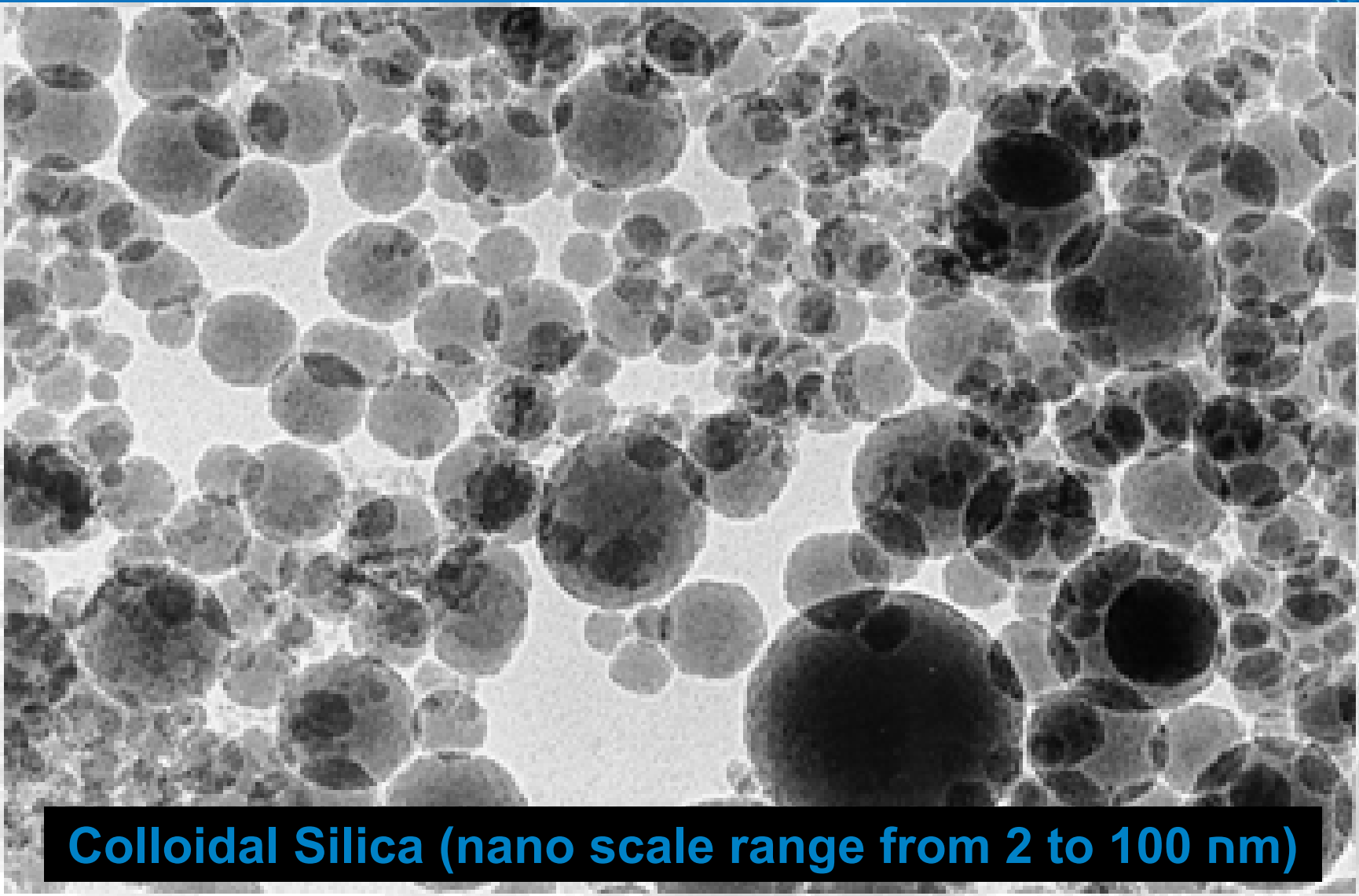
Existing Limitations (cont.)

Cost

- High raw material costs:
  - Fumed silica (if used)
  - Addition of high amount of binders
- Cost in time
  - Slow drying due to low solids
  - On site preparation of formulations

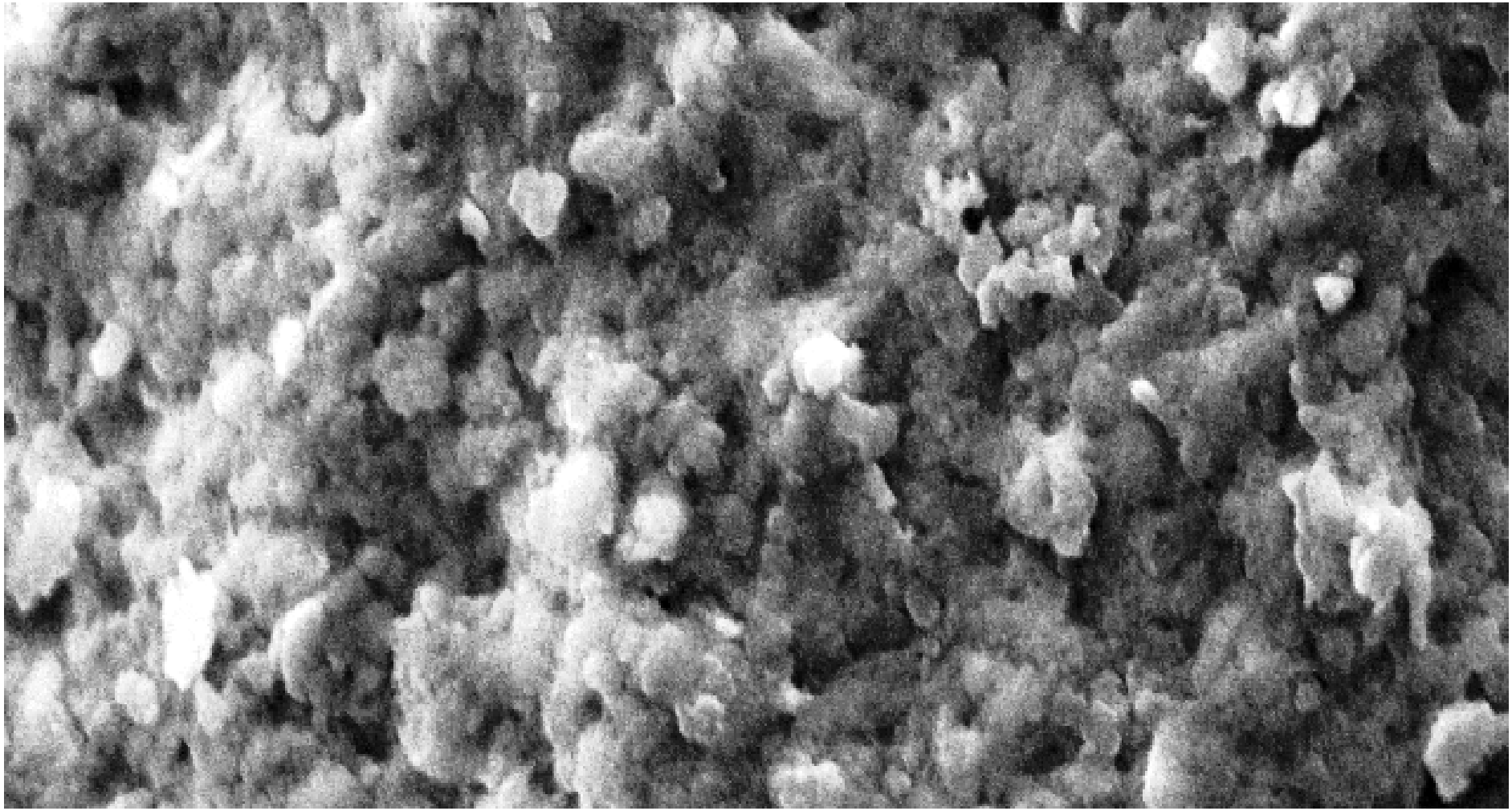
Nano Particle Coating (NPC)

NPC Binding Mechanism



Colloidal Silica (nano scale range from 2 to 100 nm)

NPC Formulation

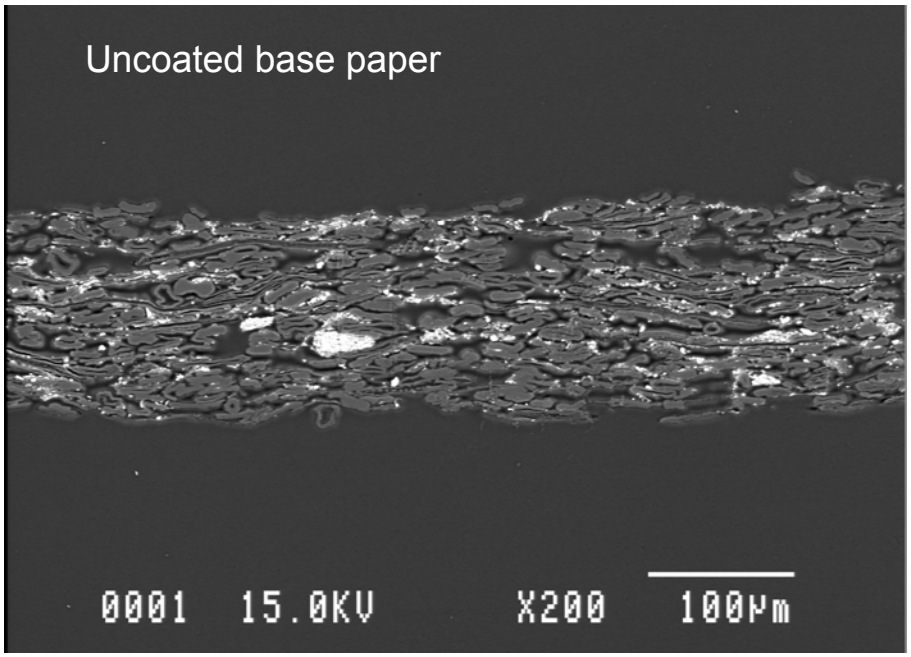


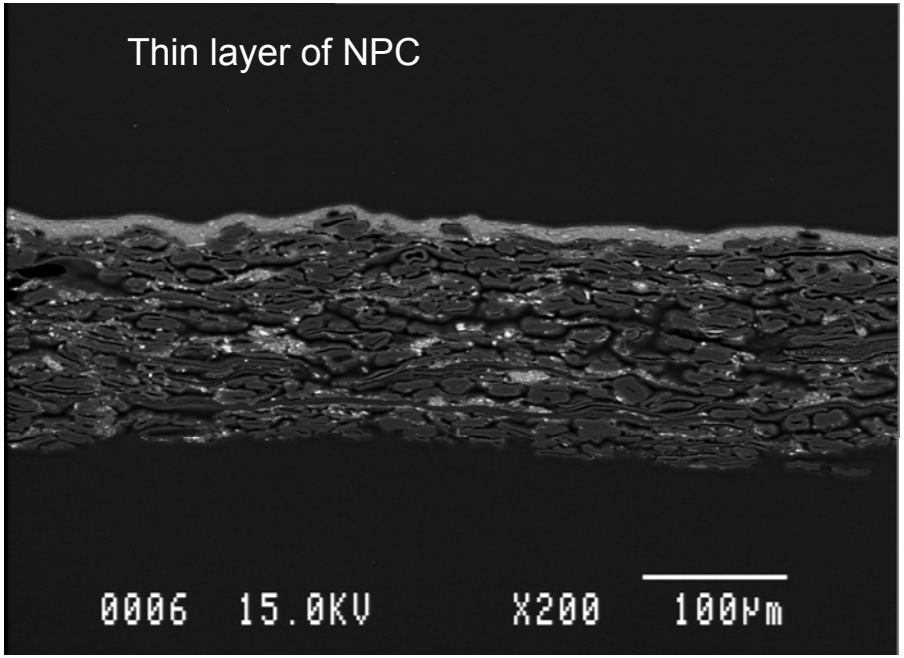
NPC Properties

NPC Coating Properties

- Brookfield viscosity: 300 to 500 cps
- Water retention value: <80 g/m2
- pH slightly acidic

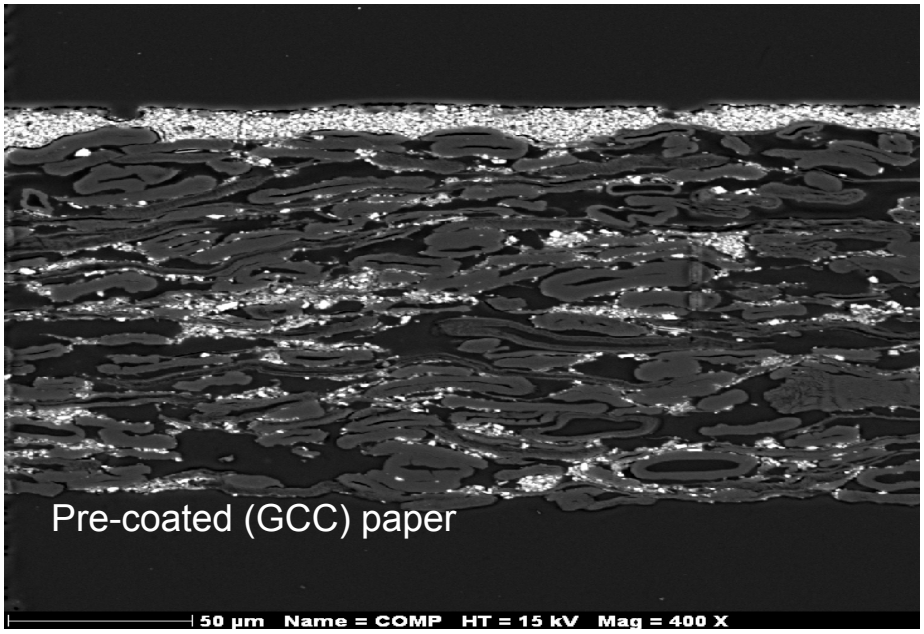
NPC Micrographs

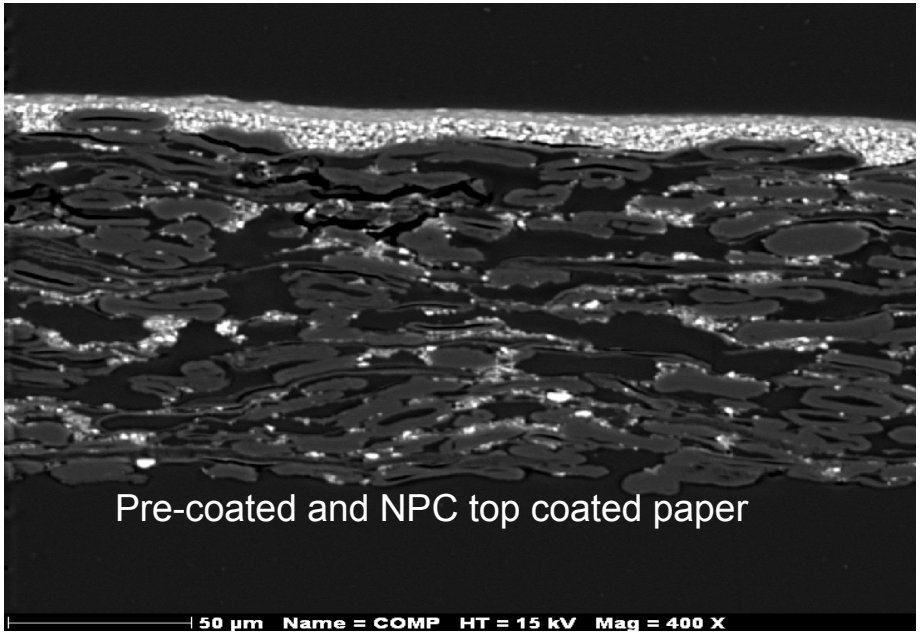




- **Left: uncoated base sheet**
- **Right: same base sheet coated with NPC**
  - NPC follows the contour of the paper
  - Does not penetrate into the base sheet

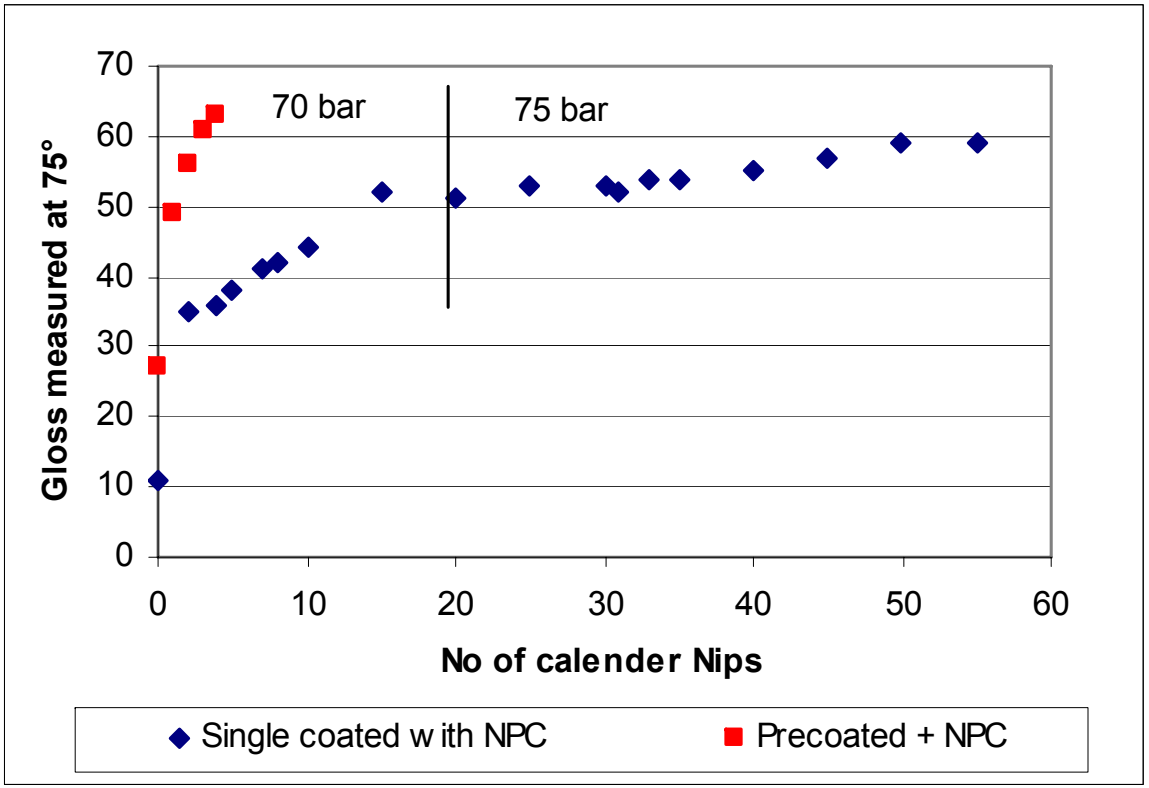
NPC Micrographs (cont.)





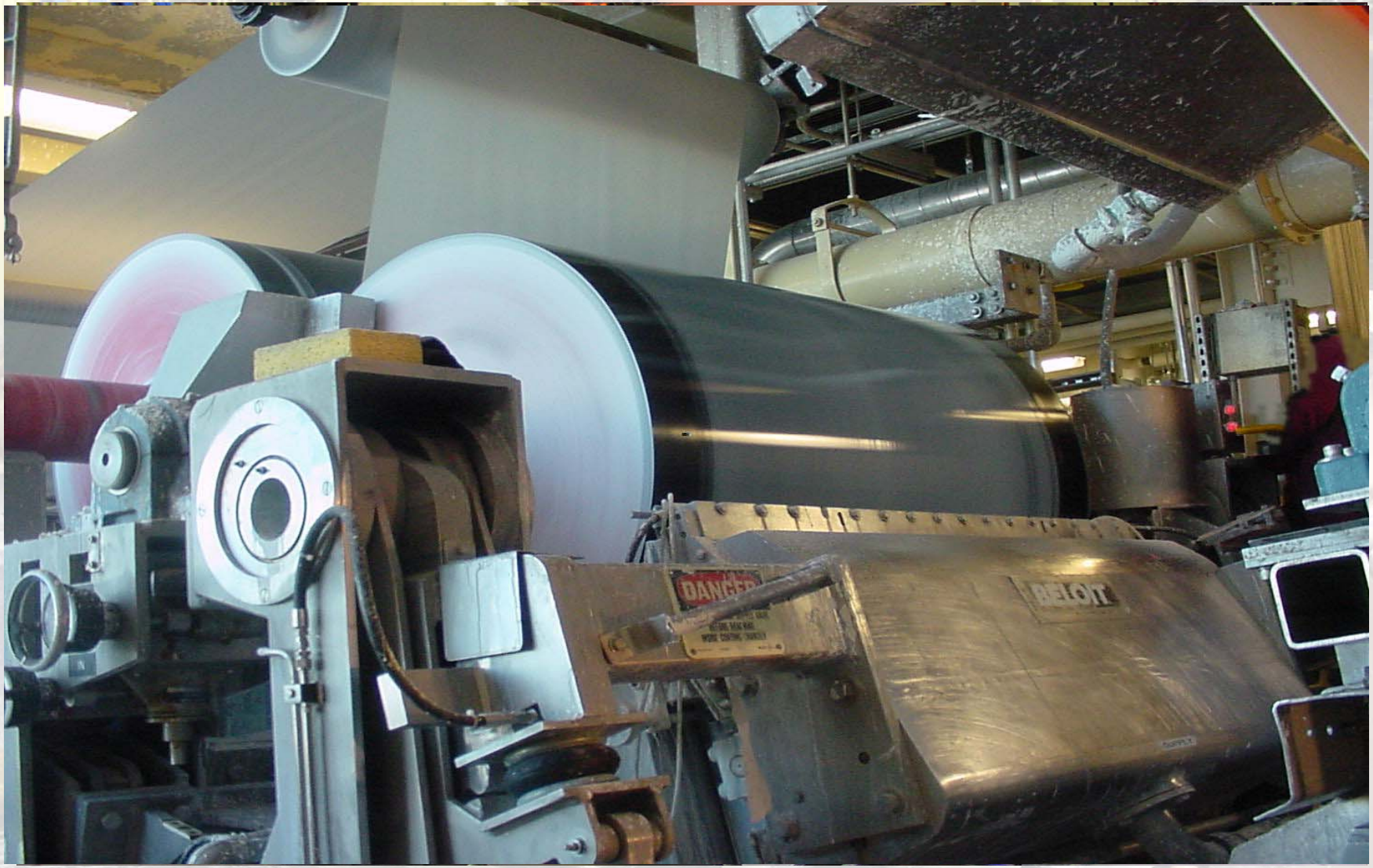
- **Left: pre-coated with GCC and starch**
  - Fills the voids on the surface of the paper
- **Right: pre-coated & top coated with NPC**
  - Creates smooth surface to receive ink

Results: Gloss

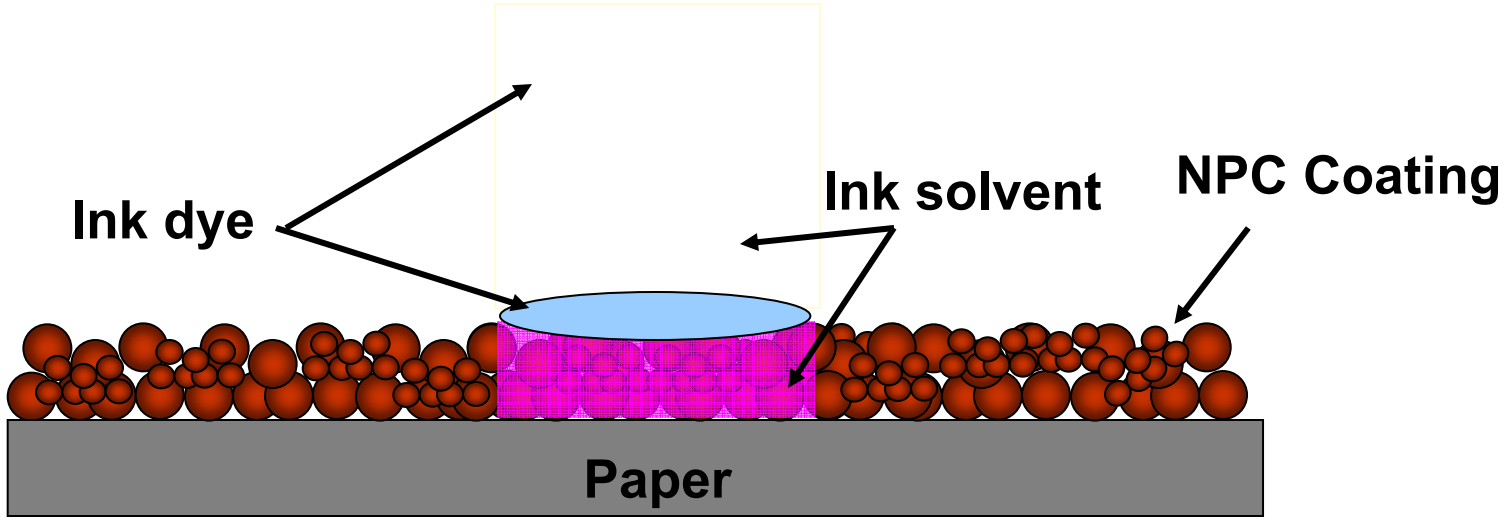


Higher gloss obtained with fewer calender nips when using pre-coated paper

NPC Pilot and Mill Trials



Ink – NPC Coating Interaction



- Silica's cationic groups fix ink dye to surface
- Ink solvent absorbs within the NPC nano structure

NPC Applications

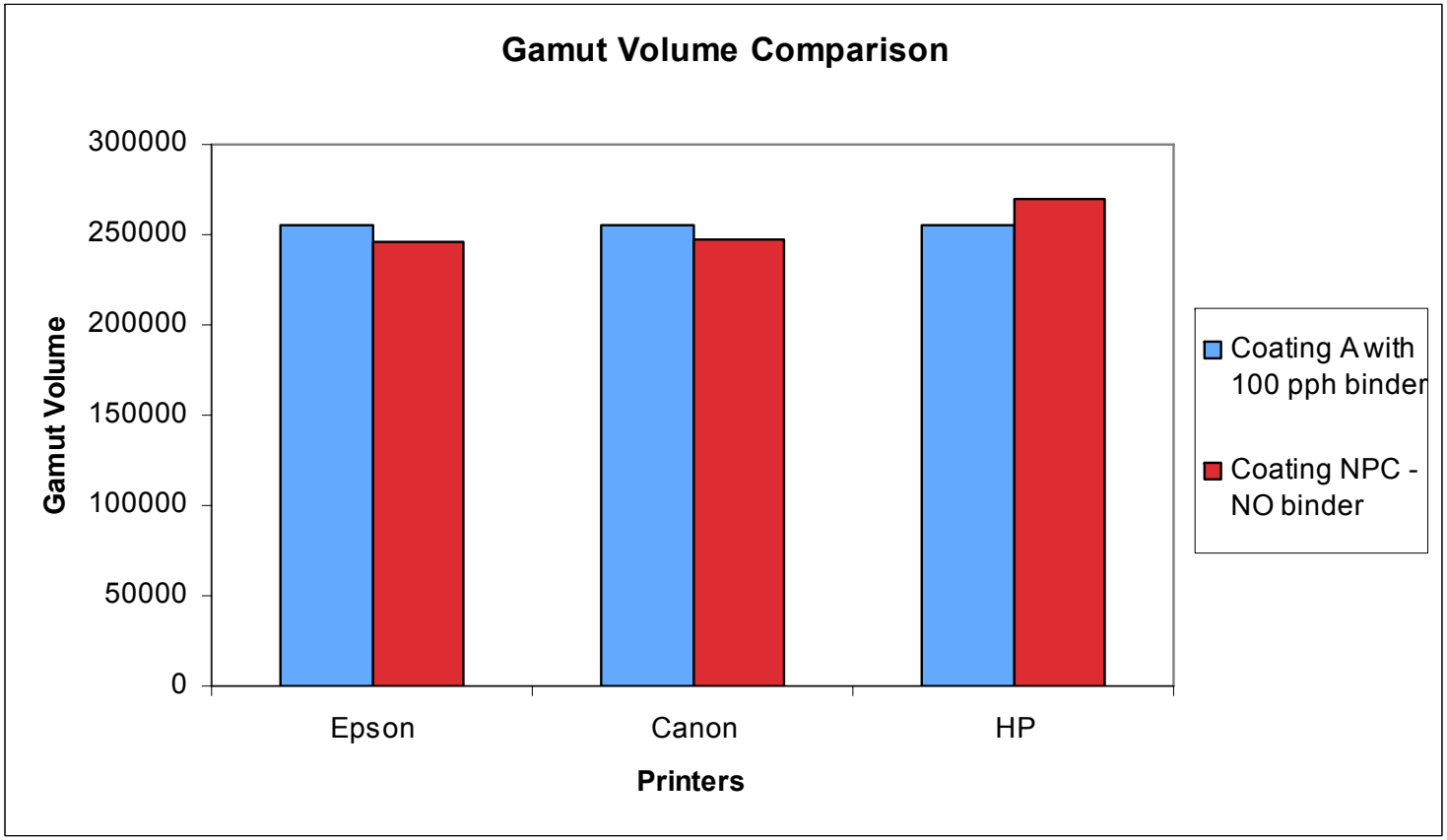
Versatility in Application:

- Coating Equipment
  - From size press to coaters
- Coat Weight Range: 1.5 to 20 g/m^2
- Multiple Aqueous Printers:
  - SOHO or Industrial applications
  - Narrow or wide format
  - HP, Epson, Canon
- Base Sheet Grammage: 65 to 230 g/m2

Case Study

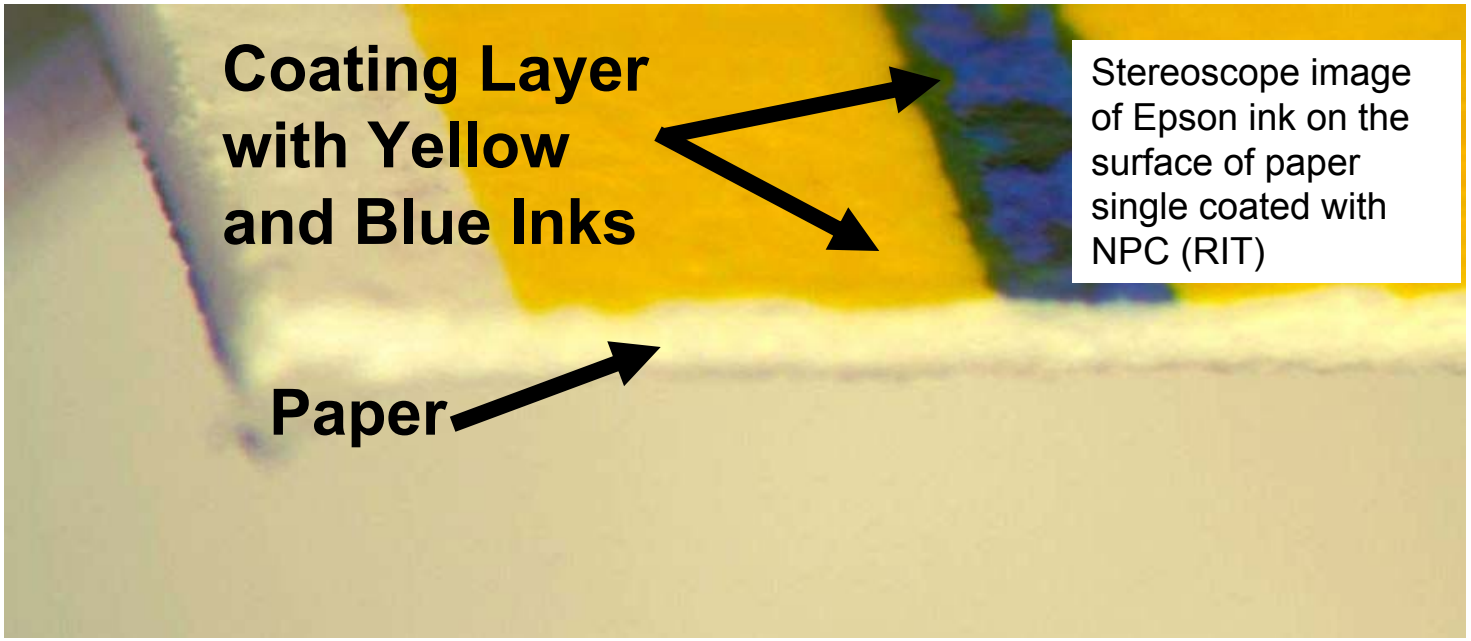
Coating A	NPC
• Silica gel based	• Nano silica based
• Primary particle size: 20 ηm	• Primary particle size: 35 ηm
• Secondary particle size: 9 μm	• Secondary particle size: 2 μm
• Solids content: 25%	• Solids content: 48%
• 100 pph PVOH binder	• No organic binder added

Case Study: Gamut Results



Similar Gamut between Coatings A and NPC

Case Study: Ink Absorption



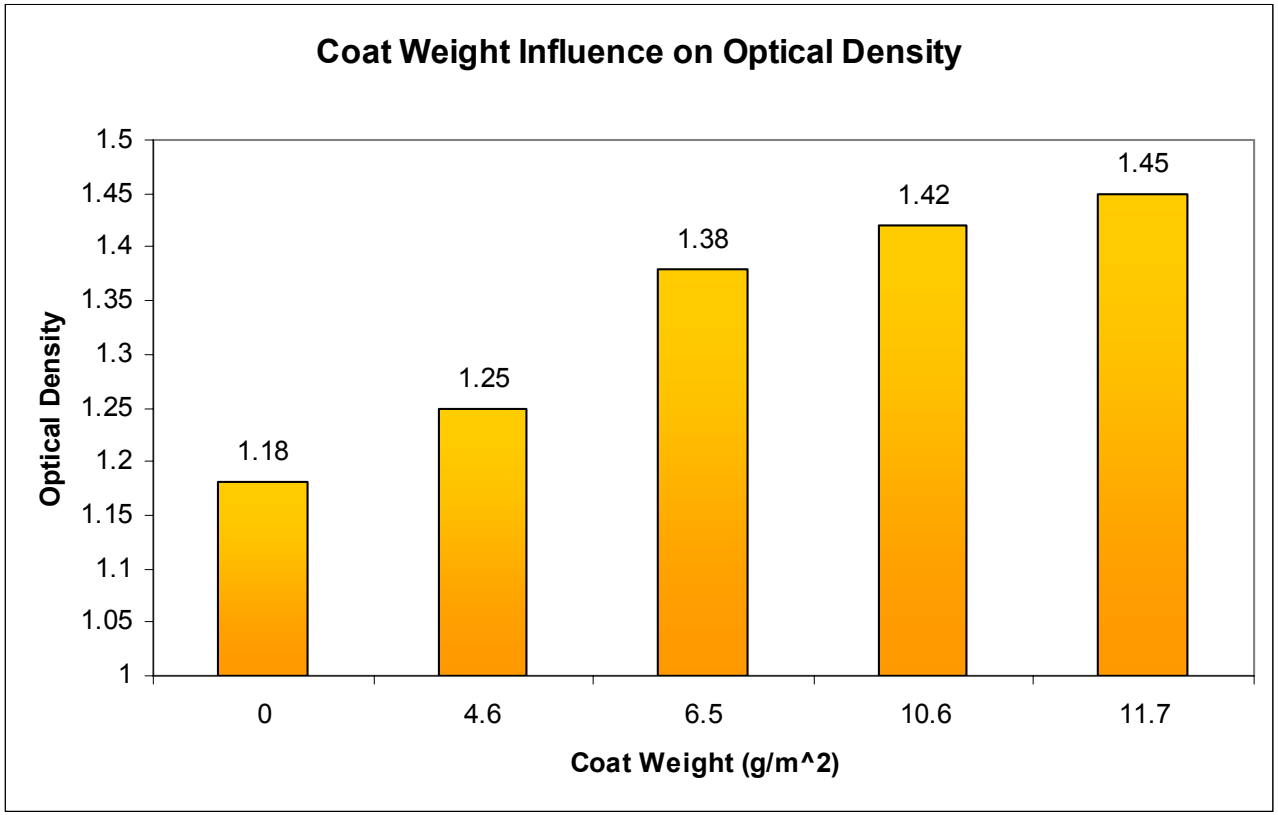
Coating NPC: Inkjet ink stayed on the surface of the paper

Results: Kodak Versamark Data

Paper Name	Grammage	Optical Density	Cockle 1-10	%Water Fast Test	%Bleed	%Wet Rub
	(g/m^2)	(High is Better)	(Low is Better)	(High is Better)	(Low is Better)	(Low is Better)
Targets		**1.20**	**3**	**99**	**10**	**10**
NPC (WMU11)	**78**	**1.23**	**3**	**104**	**7**	**6**
Image Grip VIP 20#	76	1.17	6	104	26	13
Dataspeed Inkjet Pro	92	1.16	5	97	20	10
Z-Plot 650	90	1.15	5	103	0	0
HSIJ 24#	93	1.17	5	101	11	12
Pixelle Bond VM	91	1.03	7	107	7	17
Ultra White Ink Jet	88	1.09	7	102	1	2

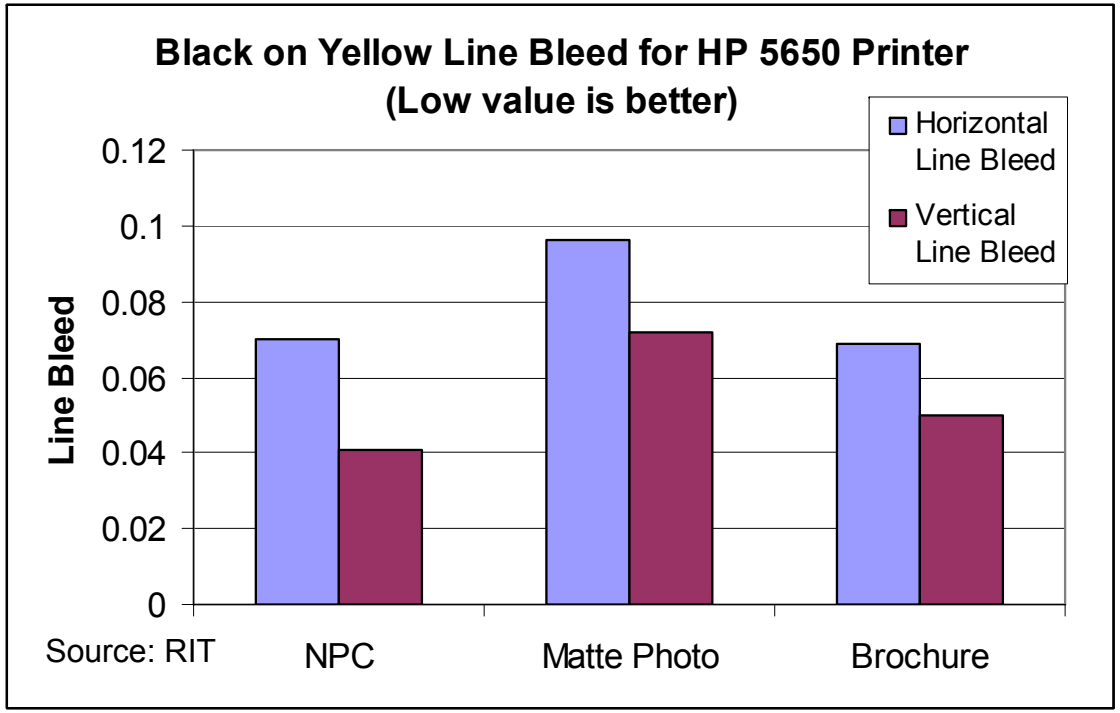
Source: Kodak Versamark Transactional Data posted on Kodak webpage and NPC Test Results Provided by Kodak

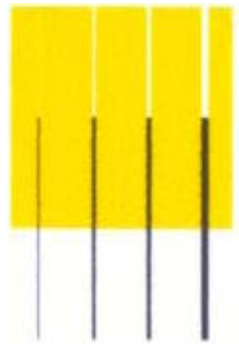
Results: Optical Density



NPC coated papers printed at Kodak on the Versamark printer showed significant optical density increase as NPC coat weight increased

Results: Line Bleed Comparison





- NPC coated papers were sent to RIT for printing, testing, and comparison to the OEM benchmark
- NPC paper performed better than the matte photo paper and similar to brochure paper

Results Summary

Lab studies, pilot, and mill trials show that NPC has good:

- Runnability
- Print quality
- Color gamut
- Water permanence
- Color performance
- Dimensional stability

Future Work

- Work will be performed to determine metrics for:
  - Image Permanence
  - Visual Appearance

Conclusions

Nano Particle Coating (NPC) Technology:

- Ready to use
- Good runnability in spite of having:
  - No organic binder
  - High solids
- Suitable for mills or coating facilities
- Similar or better inkjet printing properties than the benchmark (print density, gamut)
- Suitable for matte and semi gloss paper grades

Thank you!

Are there any questions?