Surface Modification of Carbon Black
Next Generation Inkjet Pigments

Paul Palumbo

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Outline

• Generation 1 Pigments
  – Simple diazonium treatment
  – Dispersion and Ink properties

• Generation 2 Pigments
  – Conceptual design
  – Secondary attachment
  – Polymer attachment
  – Properties

• Laser Quality
Some Basic Functional Groups

- $\text{CO}_2^-$
- $\text{SO}_3^-$
- $\text{OH}$
- $\text{B(OH)}_2$
- $\text{PO}_3^{\text{\text{\text{-}}}}$
- $\text{CF}_3$
- $\text{NR}_3^+$
- $\text{O}_2\text{C}$
- $\text{NH}$
- $\text{CO}_2^-$
Generation 1 Inkjet Pigments

✔ Light Stability
✔ Dispersion Stability - Charge and Particle Size
✔ Print Head Reliability - Purity
✔ High Optical Density
✔ Improved Intercolorbleed
✔ Improved Waterfastness
Optimizing these performance properties generally requires formulation with surfactants and polymeric additives.
Generation 2 Inkjet Pigments

Eliminate the need for ink additives...

Achieve all performance goals through surface groups.
Network-Forming Groups Attached to Surface
Secondary Surface Chemistry

Diazonium Reaction

Reactive Intermediate

Pigment
Carbon Black
Secondary Surface Chemistry

- First group provides a “hook”
- Second group introduces the desired properties
- Now it’s possible to attach groups that are not compatible with diazonium chemistry
- Many variants
  - Condensation reactions
  - Coupling reactions
  - Addition-elimination reactions
  - Displacement reactions
  - Etc...
Reactive Surface Groups

- COCl
- CON₃
- SO₂Cl
- COOEt
- COOEt
- O
- O
- O
Reactive Functional Groups: Vinyl Sulphone

\[
\begin{align*}
\text{pH} > 12 & \quad \text{Reaction} \\
\end{align*}
\]
Attachment via Vinyl Sulfone Surface

- Polyethylene imines
- Amino alcohols
- Dendrimers
  - Starburst
  - Astramols
- Polyols
  - Polyvinyl alcohol
  - Sorbitol
  - Sugars and Polysacharides
- Gelatin
- PEG, PPG
- Other polymers
Polyethylenimine

- Highly cationic
- Waterfast in 5-10 minutes
- Improved smear
- Binds well to many surfaces
Reactive Functional Groups: Amine

**Reaction with:**
- Anhydrides
- Acid chlorides
- Lactones
- Active esters
- Alkyl halides
- Vinyl sulphones
- Polystyrene co-acrylic acid
- Polyacrylic acid
- Etc.
Succinic Anhydride

- Adjust isoelectric point
- Formulation flexibility
- Optimize for specific media
Polystyrene co-Acrylic Acid

- Covalent polymer attachment
- Excellent smear resistance
- Waterfast in 1 minute
- Very rub resistant
- Media independence
Reactive Functional Groups: Vinyl

- Grow polymers from surface
- Vary monomer mix
Laser Quality Goals

- Print speed = dry time
- Print quality
  - OD, edge acuity, intercolorbleed, etc.
- Print durability
  - Waterfast, smearfast, rub resistant, etc.
- Printhead reliability

*Generation 2 pigments are enabling!*
Thank You!