Advances in Industrial Inkjet for Automotive Surfaces

Phil Collins
Director – Advanced R&D
The GIS EcoSystem

Complete image management from pixel to drop

GIS

Software

Datapath Electronics

Ink Delivery Systems

We work with customers from R&D, Prototype Development - through to Production
Phil Collins

- Engineer and mathematician
- Director – Advanced R&D
- 35 years experience in graphics and printing
Agenda

- Inkjet Technology Background
- Inkjet in Industry
- Technology Update
- Automotive Hard-Coats
- Case Study: Coating a Real Product
Inkjet Technology: Piezo-electric nozzle

The dominant technology in industrial inkjet is piezo-electric drop on demand
Inkjet Technology: Printheads

- **Industrial inkjet printheads**
  - Drop sizes: 2 – 200 picoLitres
  - Firing rates: 10 – 220kHz
  - Highly integrated: 1000’s of nozzles per head
  - Modular and scalable
  - Long operating life: $\sim 10^{10}$ operations
  - Printheads and variants for many applications
Inkjet Technology: Many Benefits

- Non contact
- Additive process
- Subtractive process
- Broad fluid capability
  - UV curable fluids
  - Conductive fluids
  - Jettable polymers & dielectrics
  - Jettable active & passive electronics
  - Acid resist
- Precise drop formation
  - Small drops for small features
  - Large drops for coatings/area fill
- Precise drop location
- Conserves expensive materials
- Reduces cost
- High drop production rate capability
- Long printhead life
  - Heavy duty cycle capability
- Proven reliability in production environments
- Inkjet as a partial or complete solution
- Integrated into standalone & hybrid manufacturing systems
- Highly integrated, modular technology
Inkjet Technology: Key Benefits

- Precise drop formation
- Accurate non-contact deposition
- All under digital control
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Disclaimer

Global Inkjet Systems supplies inkjet technology and components to 150+ original equipment manufacturers world-wide. As a matter of policy, we do not disclose our customer relationships.

These slides contain images chosen to illustrate the range of inkjet print systems which is available in the market. The presence, or absence, of any manufacturer’s products in these images does not in any way imply a commercial relationship between that manufacturer and GIS.
Inkjet in Industry: Ceramics

Inkjet now dominates ceramic tile production

That floor looks like stone - but it isn’t
Digital print for textiles has reduced minimum viable print run lengths and shortened turnaround times
Inkjet in Industry: Décor

Graphics and textures for all kinds of decorative products: wall coverings, edge banding, flooring, doors, window frames, furniture…

Image Sources: Hymmen, Cefla, Interprint
Inkjet in Industry: Automotive

- Decoration and protective coatings
- Mostly partial coverage so far
- Still some way from mainstream product
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Technology Update: Throw Distance

Inkjet is usually associated with throw distances of 0.5 – 4 mm. Surface curvature creates a requirement to jet further.

- Convex: \( r \geq w \)
- Near-convex: \( h < h_{\text{max}} \)
Technology Update: Throw Distance

This is a droplet drag model for:
- 70 picoLitre drop
- Nozzle velocity 6m/s
- Density ~1000

Although this is a theoretical model it seems to hold quite well in laboratory tests across a range of drop sizes and speeds.

The drops lose their way once they slow down to below ~1m/s.

A distance of 30-40mm is achievable for coating applications.

For print and graphics, 5-10mm is more realistic.
Technology Update: Viscosity Range

**Xaar** has released experimental data showing that their TF Technology® printheads are capable of jetting fluids at much higher viscosity than previously thought.

**Ricoh** has also disclosed information about jetting high viscosity fluids.

Not yet commercially available, but it points the way towards inkjet application of all kinds of paints and coatings.
Technology Update: Complex Curved Surfaces

Last year, GIS showed spherical objects which were printed with graphics using rotational motion under a 4 colour CMYK printhead array.
Technology Update: Complex Curved Surfaces

GIS has developed tools for designing print operations on complex curved surfaces
• First the designer places a series of points across the surface, guided by an interactive display of the area which will be printed
• The points are joined to form a path, and given a flying height.
• The designer also adds masking as required

When the path is complete, the system generates:
• Instructions for a robot moving either the printhead or the object, and
• Image data for the print, including masking:
  • Implicit – where drops don’t reach the surface
  • Explicit – where the designer adds it
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Automotive Hard-Coats

Hard-coats are an early market opportunity for inkjet
• Some are already available in inkjettable formulations
• There are many new requirements for coating plastic components
• Significant cost savings are possible
  • Materials savings
  • Process efficiencies
  • Environmental controls
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Case Study: Wing Mirror Cover

• Based on commercial work

• Objective: to apply an approved automotive hard coat* by inkjet over the exterior surface

• Using a generic after-market product with no commercial confidentiality restrictions

*Momentive SilFORT UVHC3000K
Case Study: GIS Print Path Designer
Case Study: Swathe Visualisation
Case Study: Swathe Masking
Case Study: Across The Valley
Case Study: Masking and Density
Case Study: The Movie
Summary

• Inkjet is a mature technology which has already brought benefits to many industries
• There are early market opportunities in automotive, for example with hard-coats
• And our ambition reaches much further
Any Questions?

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