Inkjet Surface Decoration - Market Overview & Challenges

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Global Inkjet Systems

• Leading supplier of software, drivers, firmware & electronics for industrial inkjet printheads to OEMs, machine builders & integrators
  • Specialise in challenging/complex applications
    • Particular expertise in large single pass systems
    • Experienced in handling high data rates (high speed, high resolution, large numbers of printheads)
  • Significant presence in ceramic tile printing, security printing, labels, packaging, textiles, product decoration, demanding variable data applications, 3D printing, coatings and materials deposition
Inkjet Surface Decoration - Agenda

• What is inkjet trying to replace – or complement?
• Understanding surfaces
  • Flat, curved, cylindrical, complex
• (Some of the) Challenges for inkjet
• Who’s doing what in the market
  • A review of products at recent trade shows
Inkjet Development in Direct Product Decoration

- Flat & Semi-Flat
- Tubes/Cylinders
- Cones
- Tubs
Decoration of Flat & Semi-Flat Objects – example systems

Mimaki based units

Pad Print Machinery

Cyan Tec

Industrial Inkjet

ITW TransTech
Categories of Shapes

<table>
<thead>
<tr>
<th>Flat</th>
<th>Tube</th>
<th>Cone</th>
<th>Bottle</th>
<th>Sphere</th>
<th>Tub</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Flat" /></td>
<td><img src="image2" alt="Tube" /></td>
<td><img src="image3" alt="Cone" /></td>
<td><img src="image4" alt="Bottle" /></td>
<td><img src="image5" alt="Sphere" /></td>
<td><img src="image6" alt="Tub" /></td>
</tr>
</tbody>
</table>

- **Continuity in direction of print**
- “Continuous” shapes – curvature remains constant in direction of print
  - Tube, cone (mixed resolution, but still continuous), bottles, spheres etc
- “Discontinuous” shapes – curvature changes
  - Tub (mixture of flat edges and curved corners)
  - Correction required keeps changing
  - Discontinuity across the printhead – adds considerable complexity
Analogue Direct Product Printing Technologies

- Tubs: ~9 - 12,000 units/hour
- Tubes: ~18,000 units/hour
- Round cups: ~27 - 36,000 units/hour
- PET bottles ~36,000 units/hour
- Cans ~ 108,000 units/hour
  - All productivity numbers are dimension dependent
Unfolding or “Flattening” Shapes

- Allows us to understand the complexities of printing onto that surface
  - Cylinders
    - Slice a cylinder down one side – unfolds/flattens to a simple rectangle
  - Cones
    - Cones unfold into “arced” rectangle
  - Tubs
    - Tubs are combinations of cones and cylinders with discontinuities
  - Bottles & Spheres
    - Bottles & spheres cannot easily be unfolded in their entirety
      - Spheres have always presented a problem
      - Bottles often highly complex
Some of the Challenges for Inkjet

- **UV curable inks dominate today**
  - Colour Gamut
    - Spot/brand colour
  - White
    - Opacity
  - Ink Wetting and Adhesion
    - Surface tension
    - Pre-treatment
    - Post-treatment
  - Curing
    - When? Pinning? Full cure
  - Resistance
    - Sunlight fade
    - Temperature
    - Scratch resistance/image durability
  - Migration
    - Regulatory issues
Some of the Challenges for Inkjet

- **Inkjet printheads**
  - Designed to print onto flat surfaces
  - Throw distance
    - Drops only jet a few millimetres and decelerate quickly
    - Larger drops jet further
    - Smaller drops improve graphical image quality
  - Distance between nozzle banks
    - Time of flight on curved surfaces
  - Jet straightness
  - Printhead dimensions
    - Reaching the nooks & crannies

- **Need to manage physical characteristics of printhead in relation to curved surface**
  - Jet straightness
  - Time of flight
  - Distance between nozzle banks
  - Image compensation – where applicable
Continuous curves – cylinders/tubes and cones
Tubes/Cylinders

- A “flat” image wrapped around a cylinder
  - No image compensation required
- Physical characteristics of the printhead
  - Geometry
  - Drop ejection
  - Time of flight
Printhead Orientation

- **Orientation of the object under the printhead to get best possible print**

- **Three key issues**
  - Symmetry
  - Nozzle bank width
    - The narrower the better
  - Number of columns
    - Different times of flights
    - More complex

- **Printhead orientation**
  - Printing downwards
  - Printing sideways (printhead dependent)
Printhead Geometry

**Single column**
Easiest, but lower resolution

**Dual column shared wall**
Symmetrical, narrow is better

**Multiple columns**
Faster, complex but some printheads have independent fire control, which helps
Cones

Continuous shape, but more complicated than a tube

- Nozzle alignment issues as before
- Resolution changes when printing onto curved surfaces
- Need to compensate for density increase
- Screening more complex
Printing with No Correction

- Nozzle misalignment
- Increasing density
- Time of flight differences
- Screening issue - changes in dot gain

High Resolution

Low Resolution
• Density and screener correction software
Printing with Correction

- Correct nozzle alignment
- Density correction
- No dot gain issues
- No screening artefacts
- Image distortion – typically managed in original artwork

Curved surface compensation
Printing Onto Bottles

- Huge range of shapes of bottles
- Labels/decoration typically on the tube section
- Printing more of the bottle presents new challenges as often different corrections required
  - Combination of tubes & cones
  - Some have discontinuous shapes e.g. a tub-shaped base
  - Plus ridges etc
Printing onto Complex Bottles

• Multiple angles may be required to print the entire surface
  • Neck ridges
  • Narrowing of middle section
  • Some areas almost impossible to reach

• Simplistic approach shown here
  • Print quality will vary dramatically – needs large drops for the throw distance
Discontinuous curves - tubs
Discontinuous Shapes

- Mixture of flat and curved surfaces
- The required corrections change during the print (often from pixel to pixel)
- GIS multi-dimensional nozzle, density and screener correction technology that can be adjusted to each surface type and associated application process
Products at Recent Shows
Drinktec: K 2013: SGIA: Label Expo: InPrint
Non-inkjet decoration systems at recent shows
Non Inkjet – HP Indigo

• White conformable PE
  • Print surface top coated and optimized for HP Indigo presses
Non Inkjet – HP Indigo

- Personalised hats for construction industry
- Pre-distorted images printed onto PET-G sheets
- Vacuum wrapped onto hats
- Artwork takes on correct format
- First introduced in 2011
Non Inkjet - Xeikon

- Xeikon 300 series
- Thermoflex heat transfer system
- Print (mirror image)
- Heat/pressure applicator (3rd party equipment)
- QA-I toner – FDA indirect/direct food contact (conditions apply)
- First introduced 2011
Inkjet - flat & semi-flat systems
Mimaki Print Robo 60

- 2 x UJF-6042 units
- XY printing
- Up to 1800 x 1800dpi
- Jig plate (600mm x 420mm)
- 20 jig plates auto loading
Durst Rho IP 203 & 507

- “Plastics, membrane switches, instrument panels, dashboards, cover plates (e.g. for washing machines) and small objects for which pad printing is typically used.”
- 1000dpi
- Up to of 8 colours
- Rho IP 203: 210 x 297 mm
- Rho IP 507: 500 x 700 mm
- [www.durst.it](http://www.durst.it)
Thieme 3000D Series

- KM1024 heads
- 3 heads per colour
- 8 inks CMYK, Lc,Lm,Lk, W plus optional primer, topcoat
- Print sizes
  - Thieme 3020: 750mm x 1,050mm
  - Thieme 3060: 1,550mm x 2,100mm
  - Thieme 3095: 2,000mm x 3,300mm

- [www.thieme.eu](http://www.thieme.eu)
Plastic Cap Printing

- **Sacmi Intesa – Colora Cap**
  - Xaar 1001

- **Tampoflex – Big Wheel**
  - Hybrid inkjet & rotary pad print
  - KM1024

- **PPSI – custom built unit pharma**
  - Xaar 1001
Inkjet – cylinder/tub, cone & tub printing systems
• Innovative Digital Systems (IDS)
  • Adaptation of Mimaki system
• INX – Evolve CP100
  • Xaar 1001 printheads
Dubuit 9150

800 pcs/hour (dimension dependent)
  • Diameter: 10 to 100mm
  • Height: 40 to 200mm

Flat or curved surfaces
360dpi greyscale
CMYK + W
Small system footprint

www.dubuit.com
Hinterkopf D240

- Inline inkjet system
- Up to 240 pieces/min (dimension & resolution dependent)
- Up to 1200 dpi
- Precision rotary indexing machine with 16 stations & 32 spindles/holders
- Max. 8 print stations – CMYK+W – plus 2 special inks + lacquer
- Low migration UV inks
- De-dusting; detection; positioning; surface pre-treatment; printing; pinning and separate final drying; checking; removal

- www.hinterkopf.de
Kammann K1 CNC-2250

- Hybrid screen and inkjet
- CMYK – UV inks
- Xaar 1001 printheads
- 2 x screen stations
  - Pre-coat white with screen
  - Spot colours with screen
- www.kammann.de
KHS Innoprint

- CMYK+W
- Low migration/food grade UV inks
- Untreated PET bottles
- Optical resolutions of 1080 x 1080 dpi
- PET bottle types ranging in size from 0.33 to 1.5 litres
- Container diameters can vary between 40 and 120 mm
- Capacity up to 36,000 PET bottles per hour
- Each colour carousel has 12 printing units
- Modular configuration
- www.khs.com
KHS Innoprint

- Bottles enter via air conveyor
- Sterile air or nitrogen pumped in for stability
- Clamping units (pucks) transport bottles to 5 colour carousels – lock in place magnetically
- Bottle mouth sealed during printing, preventing any contamination
- Each colour carousel applies one UV ink WCMYK – then UV LED curing
Krones Decotype

- Modular, compact design
- PET, PP - glass in future
- Cylindrical and odd-shaped bottles
- UV ink – up to 6 colours

[www.krones.com](http://www.krones.com)

<table>
<thead>
<tr>
<th>Output (cph)</th>
<th>Number of colours</th>
<th>Printing level (mm)</th>
<th>Number of print heads</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Specially shaped containers</em></td>
<td>up to 6</td>
<td>up to 70</td>
<td>up to 6</td>
</tr>
<tr>
<td>up to 12,000</td>
<td>up to 6</td>
<td>up to 210</td>
<td>up to 18</td>
</tr>
<tr>
<td>up to 24,000</td>
<td>up to 6</td>
<td>up to 70</td>
<td>up to 12</td>
</tr>
<tr>
<td><em>Cylindrical containers</em></td>
<td>up to 6</td>
<td>up to 70</td>
<td>up to 6</td>
</tr>
<tr>
<td>up to 7,800</td>
<td>up to 6</td>
<td>up to 210</td>
<td>up to 18</td>
</tr>
<tr>
<td>up to 15,600</td>
<td>up to 6</td>
<td>up to 70</td>
<td>up to 12</td>
</tr>
</tbody>
</table>

*) all around print, diameter = 60 mm

Higher system performance will be ensured in future by the development of additional design sizes.
Krones Decotype
Polytype RDA 24-125 Hybrid

• Tubes can be decorated by both ink jet and/or dry-offset and followed by over-varnishing

• Combines “the positive features of both printing processes-high print quality for images with digital printing and small and sharp lettering and excellent full colours with dry-offset printing”

• 6 ink jet and 8 dry-offset stations
Polytype Digicup

• Standard cup in-feed and pre-treating stations
• Decoration with low migration process inks, including the possibility for a 4 colour bottom decoration
• UV-dryer for scratch resistant surface - then restacked on restacker
• Various shapes can be handled and decorated
  • Round, oval cups and multi-sided cups (tubs)
• 40 to 120 cups/min
• First machines installed and in production
• www.polytype.com
Till SmartPrint

- Modular SmartPrint range of machines
- 10 to 600 units/min
- UV inks and Xaar 1001 printheads
- Glass, PET and metal
- Customisable web shop
- Test systems now installed at Coca Cola, Anheuser Busch and Heineken

www.till-tech.com
Robot Printing

Industrial Inkjet – InPrint demonstration

Xennia – Xanadu system
Summary – Inkjet Meeting Market Demands

• **Market enablers becoming available**
  • Inks
    • Drop size/ resolution/ print quality
    • Low migration/low odour
    • Adhesion
    • Recyclability
  • Inkjet reliability
  • Non-contact / digital
    • New opportunities
  • New processes
    • Curved surface compensation
    • Software tools
  • Supporting technologies
    • Pre-treatment/ curing/ post-treatment

• **Production capability becoming feasible for some markets**
  • Matching (or close to) matching analogue throughput for some products
    • PET bottles
    • Tubes/cylinders
Thank you – Any Questions?

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