Inkjet Market & Technology Update
Coating & Decoration of Glass
- Flat, Container & Industrial -

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GlassPrint Conference
Düsseldorf 27-28 November 2019
The GIS Inkjet EcoSystem

Complete image management from pixel to drop

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

• Update on markets & technology
  • More market entrants – particularly in flat glass
  • Container – increasing adoption
  • What (potentially) lies ahead

Image source: Dip-Tech, AB InBev & Taylor Autoglass
Disclaimer

Global Inkjet Systems supplies inkjet technology and components to 130+ original equipment manufacturers world-wide. As a matter of policy, we do not disclose our customer relationships.

Some of the following slides contain images chosen to illustrate the range of inkjet print systems which are 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.
Flat Glass

Overview and Latest Market News
Flat Glass

- **Established**
  - Architectural
  - Décor
- **Developing**
  - Automotive
  - Appliance

- **News / developments from the last 12 months**

Image source: Dip-Tech and Tecglass
**Tecglass**

- **Vitro-JetF-Type Side Kinetix** – launched at Vitrum 2019
  - Heads move crosswise to the print carriage, lengthwise relative to the support table
  - 48 printheads

<table>
<thead>
<tr>
<th>SINGLE PASS</th>
<th>printing at 360 dpi</th>
<th>up to 440 sqm/hour.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOUBLE PASS</td>
<td>printing at 720 dpi</td>
<td>up to 230 sqm/hour.</td>
</tr>
<tr>
<td>4 PASS</td>
<td>printing at 1080 dpi</td>
<td>up to 120 sqm/hour.</td>
</tr>
<tr>
<td>6 PASS</td>
<td>printing at 1440 dpi</td>
<td>up to 85 sqm/hour.</td>
</tr>
</tbody>
</table>

[Image source: Tecglass](https://www.youtube.com/watch?v=dH7YY99RA4k)
Tecglass

- **Vitro-Jet Single Pass Evolution with in-line Vitro Scan tool**
  - Up to 3.3m
  - 9m/sec
  - Up to 30 printheads (60,000 nozzles)
  - Rotation correction
  - Jetver Automotive inks
DipTech

- Glasstec 2018 - introduced a new system for printing full colour home appliance panels using new Ferro Ultra-FIX inks
  - Can produce the thick layers as well as the fine text and marks required for appliance panels
  - Dip-Tech patented technology

- Vitrum 2019 – introduced gold and white gold inks – metalized highlights for architectural & design applications

https://www.youtube.com/watch?v=P7xYYVKOWso

Image source: Dip-Tech
• **NEraD Plus** launched at Vitrum 2019

<table>
<thead>
<tr>
<th></th>
<th>NEra - D150</th>
<th>NEra - D300</th>
<th>NEra - D460</th>
<th>NEra - D Plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum glass size</td>
<td></td>
<td>Width 2800 / 3300 mm or Length: 2600 / 18000 (mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td># of Channels</td>
<td>6</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Minimum glass size</td>
<td></td>
<td>400 x 400 / 800 x 800 (mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass thickness</td>
<td></td>
<td></td>
<td>2.19 (mm)</td>
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</tr>
</tbody>
</table>

Image source: Dip-Tech
Dip-Tech

- **N ERA V** – automotive glass
  - XY scanning system
  - Dynamic registration system – complex asymmetric glass panels

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<thead>
<tr>
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<th>NERA - V300</th>
<th>NERA - V460</th>
<th>NERA - V Pluse</th>
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<tr>
<td>Maximum glass size</td>
<td></td>
<td>3300 x 2600 (mm)</td>
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<tr>
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<td></td>
<td>2-19 (mm)</td>
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Image source: Dip-Tech
• **PW260 & SR450** with automatic registration recognition systems that let operators change parts on the fly – launched at Vitrum 2019
Keraglass

- **Dinamica** – launched at Vitrum 2019
  - In line heating and drying
  - Single or multipass printing
  - 10-22 heads per bar (Xaar 2001)
  - Automotive & home appliance panels

[Image](https://www.youtube.com/watch?time_continue=131&v=osBmtKGL324)
Tecnoferrari

- Collaboration with Giardina Group – finishing & handling systems for glass industry – Vitrum 2019
- VivaJet single pass Series
  - Print width up to: models (S) 910 mm, (M) 1190 mm, (L) 1470 mm
  - 360dpi
System Ceramics

- **Creadigit – single pass**
Rollmac & Gemata

- **Glassprint One – launched Oct 2018**
- Gemata software & Caldera RIP
- Certified for the use of TORRECID ceramic inks
- 6-12 colours
- Xaar 1003 printheads
- XY scanning

Image source: Rollmac

<table>
<thead>
<tr>
<th></th>
<th>6 heads</th>
<th>12 heads</th>
<th>18 heads</th>
<th>24 heads</th>
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</thead>
<tbody>
<tr>
<td><strong>Type of heads</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Type of print</strong></td>
<td>Xaar 1003 GS6S Hexachrome</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Number of heads</strong></td>
<td>6</td>
<td>12</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td><strong>Band dimensions</strong></td>
<td>70,5</td>
<td>140</td>
<td>210</td>
<td>280</td>
</tr>
<tr>
<td><strong>Minimum resolution</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum resolution</strong></td>
<td></td>
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<tr>
<td><strong>Levels of grey</strong></td>
<td>NR</td>
<td></td>
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<tr>
<td><strong>Dimensions of the droplet</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Number of rows of heads</strong></td>
<td>NR</td>
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<tr>
<td><strong>Print head translation speed</strong></td>
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<tr>
<td><strong>Productivity at 360 DPI</strong></td>
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<td><strong>Productivity at 1440 DPI</strong></td>
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https://www.youtube.com/watch?v=kZKFPotGbQ&feature=emb_logo
Cefla Finishing

- **J-Print Series**
  - Focus on interior glass applications
Example Printheads used in Flat Glass

- **TTEC**
  - CF1
  - CF3
- **Xaar**
  - 1003
  - 2001
- **Seiko**
  - RC1536
- **Fujifilm**
  - StarFire

Image source: TTEC, Xaar, Seiko, Fujifilm Dimatix
Recirculating Ink Supply

- **Recommended for heavily pigmented inks and challenging fluids**
  - Controls two pressure environments to generate a pressure differential across a printhead
  - Pressure difference can be adjusted to suit the printhead and fluid combination used
  - Allows thermal control of printhead (with in-line heater) and effective degassing
  - Allows effective priming of printhead
  - Gives increased reliability
  - System operation and fluid condition is more consistent and any environmental effects minimalised
Dynamic Registration

- Key challenge is alignment & registration with the substrate
- Many different possible distortions can be solved by:
  - Mechanical (feeding)
  - Vision systems + software

Image source: Tecglass
Dynamic Registration

Translation (X & Y)

- Product detect (X translation)
- Feeders or software offset (Y translation)

Rotation

- Feeders
- Vision system + fiducials + software

Mesh based correction accurately places finishing data in the desired location. Handles all translation, rotation, stretch, compression and skew as well as localized distortion correction.

- General software conversion approach
- If you can measure the error – it can be corrected
Hollow Glass

Bottles / Containers / Drinkware

Overview and Latest Market News
Cylinders, Cones & Tubs

**Cylinders well established/well understood technology**

**Cones or conical/tapered shapes**

**Software correction**

For full wrapping
- Corrects nozzle alignment
- Provides density correction
- Ensures no dot gain issues
- Ensures no screening artefacts

**Tubs**

- Requires correction changes during the print
  - Often from pixel to pixel
  - Multi-dimensional nozzle, density and screener correction technology can be adjusted to each surface type and associated application process
Fermac

- Linear series and Rotary series

Image source: Fermac
https://www.youtube.com/watch?v=oVDUE_BHHIU
• Helix DL Series
  • MagiCoat® glass primer to make glassware pieces more durable and resistant to wash cycles
  • Cyan, Light cyan, Magenta, Light magenta, Yellow, Black, White and Varnish. DL series ink is also FDA 21CFR compliant
Koenig & Bauer Kammann

- **Range of screen & inkjet hybrid systems**
  - Round, oval, flat or angular - diameter up to 120mm - length 450mm. Max. print image height 220 mm
  - Adhesion promoter and a protective varnish

Image source: Kammann
Isimat

• **Indirect Digital Decoration (IDD)** – launched at K-Show 2019 (plastics – but also for glass)
• Inkjet onto film – transfer process to container
• Hybrid technology system
Machines Dubuit

• Dec 2018: Announced distribution partnership with Engineered Printing Solutions (EPS) in the US
Dekron (Krones – Till) – AB InBev

- Nov 2019: announced the introduction of “direct object printing” on its beer bottles. The technology is being developed in the brewer’s Tattoo Alpha Plant in Haasrode, in Leuven, Belgium.
- Previously tested the innovation on small batches to mark specific occasions – now opening up to broader mass market
- Decoration and tactile effects
- Launch in UK - part of limited-edition run of Beck’s Artist Series - nine bottle designs

Image source: Krones and AB InBev

Other
Other Flat Glass Applications

- **Functional Coatings**
  - Mobile phones
  - Touch screens

- **Display**
  - LCD colour filters
  - OLED
    - Depositing light emitting layer

- **Printed Electronics / Touch Panels**
  - Conductives
  - Dielectrics
  - Encapsulation layers

- **Solar**
  - Organic solar cells (OPV)

- **Any opportunity / demand for complex shapes?**
  - Hollow glass?
  - Industrial?

Image source: company web sites
Complex Shapes
Complex Shapes

Creation Tools

- Import Mesh & Texture
- Swathe Decomposition
- Transport Control

Swathe paths

- Measure & Correct
- Print Control

Colour Separation

- Unwrap
- Density Correction & Screening

Image source: GIS
GIS Print Path Designer

Modelling in ABB RobotStudio

Robot Calibration ➔ GIS Swathe Alignment Model ➔ Shape Measurements

Image source: GIS
Full Object Coating – GIS Print Path Designer

Image source: GIS
Black Frit - Potential Application?

- **Reasons for the black frit**
  - Contact point between the glass and car frame - assists the adhesive to stick better to the glass
  - Help preserve the urethane sealant used to bond the glass to the frame
  - Help distribute temperature evenly to lessen optical distortion
    - Frit band heats up much faster than the windshield’s glass, creating an optical distortion that makes either straight lines look curved or bowed inwards
    - The gradual black dots help lessen this phenomenon by dissipating the heat and spreading it out evenly
  - Aesthetic purposes. Halftone pattern allows a gradual decrease in size - transition much more subtle
- **Amount of black frit is increasing in designs**
  - Potential distortion problems in the firing process
- **Proposition to print on the formed glass....**
Automotive Windshields

Manufacturing Process

**Step 1.** Gather raw materials
**Step 2.** Melt raw materials
**Step 3.** Pour molten glass mixture onto tin ban
**Step 4.** Gradually cool glass as it is rolled through annealing lehr oven
**Step 5.** Cut glass
**Step 6.** Cut glass to windshield shape
**Step 7.** Apply black frit to glass (when flat) - typically using silk screen / inkjet
**Step 8.** Mold glass to shape adding curvature
  - Potentially apply black frit with inkjet here in manufacturing process
  - Additional decoration?
**Step 9.** Add PVB layer to glass and lay 2nd piece of glass on top
**Step 10.** Heat the three layers in over to bond
**Step 11.** Wash, label, pack and ship windshield
Summary

• **Flat glass**
  - Automotive & appliance applications growth
  - New inkjet introductions from glass industry players
  - Other inkjet vendors seeking new markets in glass

• **Container glass**
  - Adoption increasing

• **Complex shaped glass coating / printing**
  - Technology / software becoming available
  - New opportunities? New markets?

• **Importance of ink chemistry and software**
GIS – Company Overview

• Leading provider of technology solutions to industrial inkjet systems builders
• Supported printhead manufacturers
  – Fujifilm Dimatix, Konica Minolta, Kyocera, Ricoh, SII, Toshiba Tec, Xaar
• Founded November 2006
• Based in Cambridge, UK
  – Technical support in UK, China and Japan
• Employees 70
• Patent portfolio
• Supplier & partner to over 130 customers worldwide
• Huge range of applications
The Atlas platform offers customers a variety of Software Development Kit (SDK) options.

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