Dutch Institute of Sound and Vision.

Impressive Effects of Printing Architectural Glass

Inkjet printing is an increasingly interesting option for decorating flat glass.

A few years ago, screen printing was the only method to decorate architectural glass. Versatility was one of the arguments in its favor. Screen printing is suitable for both printing and coating, and can apply the ceramic paste in virtually any thickness. Screen printing also offers the unique option to expose the glass substrate and the printed glass containing ceramic paste, which allows a high-temperature treatment to ameliorate the performance of the printed ceramic paste to such a level that the colorfastness meets its maximum specifications under different weather conditions. Other ink systems require a less intensive post-treatment such as sol-gel inks (approximately 200 degrees Celsius) and UV ink, which cure by polymerization at room temperature. However, the maximum performances (characteristics) will not be achieved.

Whereas analog print techniques such as flexo, offset, screen and gravure, are still widely used, there is a strong need for the digital approach.

Break-even Point

The consequence of using screen printing is that every new image needs a new print form.

The fixed cost is therefore rather high. It will depend on the number of print forms required. Screen printing remains a cost-effective printing method to decorate a larger number of glass panes for architectural purposes. The more panes, the more the price per item drops.

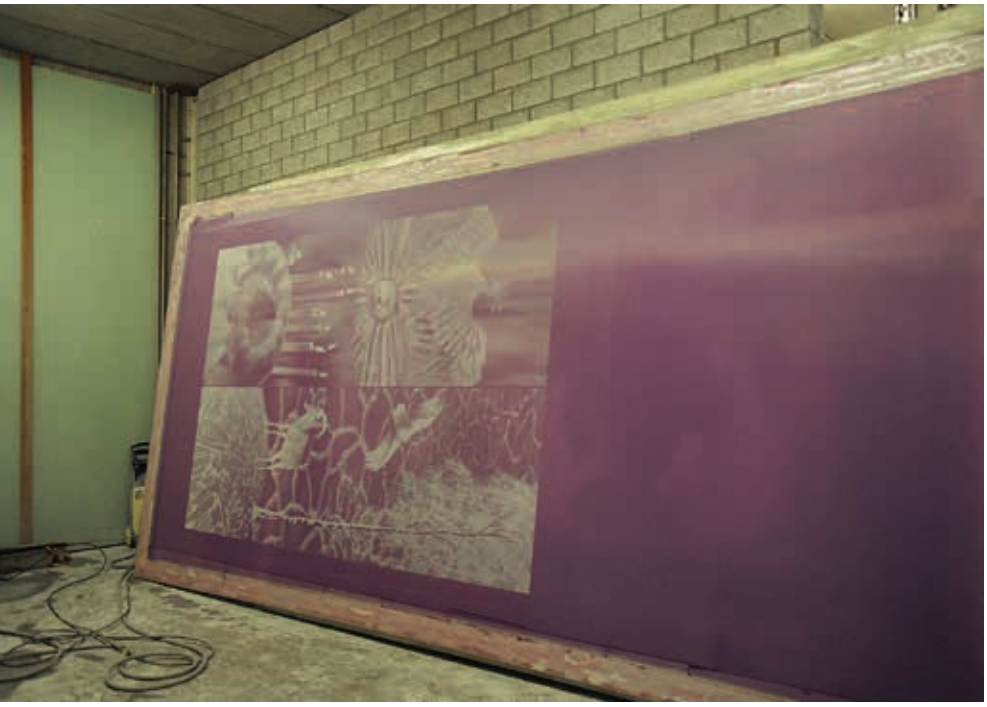
Inkjet can be used to decorate architectural glass. It plays an increasing role of importance as the cost to prepare the print form can be eliminated. Inkjet is cost-effective for printing unique copies and quantities of glass panes. Using drop-on-demand inkjet technology, substrates are printed up to the edges. The production speed has increased substantially.

The manufacturing cost by inkjet for a batch of approximately 100 panes is less than the break-even point for a screen print.

Whereas analog print techniques such as flexo, offset, screen and gravure, are still widely used, there is a strong need for the digital approach.

By Wim Zoomer, Industry Author

Dip-Tec inkjet printer based on ceramic paste.



The 7-by-2.4-meter screen printing frame used for the convent.

Digital Printers and Inks

Saint-Gobain

In 2007, Saint-Gobain Glass Solutions installed a special digital glass powder printer and used the system to print the new façade of the Dutch Institute of Sound and Vision. At the same time, the first commercial inkjet system for architectural glass was introduced. Most inkjet systems printed with an ink based on UV-curable ink technology, or a sol-gel ink. Tests using digital inkjet print techniques on architectural glass often used patented systems.

Dip-Tech

Israeli company Dip-Tech has installed hundreds of ceramic inkjet systems that process durable prints in vivid colors on virtually any size glass panel. The company focuses on glass printers for outdoor and indoor purposes.

Dip-Tech also supplies printers to manufacture automotive glass. The digital inkjet system offered is complementary to the possibilities traditional screen printing offers, explained Yariv Ninyo, Dip-Tech's VP Business Development. Ninyo said, "Glass manufacturers are, in general, not familiar with the process of printing. The inkjet printer is an appreciated tool in their production environment!"

Besides inkjet printers that can manage sizes up to 3.3 by 6 meters, Dip-Tech supplies inks for tempered and laminated glass. The company also supplies special products, such as anti-skid inks, conductive inks for defrosters, GPS systems and radio antennas. Furthermore, Dip-Tech offers six colors (black, white, blue, orange, green and red), special color matches and etching ink to create a sandblast effect without the need for a mask.

Ceramic ink supplier Ferro Corporation, an international firm based in the United States, acquired Dip-Tech in August 2017. Dip-Tech's Managing Director Alon Lumbroso said, "The most important benefit of this acquisition is being able to expand Dip-Tech's portfolio of products. Ferro is a specialist in the field of raw materials, whereas Dip-Tech is allowed to pick up the most appropriate product."

Ferro has sales offices in 28 countries and over 5,000 employees, whereas Dip-Tech is commercially active in 60 countries with only 110 employees. Additionally, Ferro is appreciated by its customers as a very strong, stable and professional company. "Dip-Tech's customers feel confident to purchase the corresponding digital equipment from us," said Lumbroso.

Along with Dip-Tec/Ferro, Durst and Tecglass manufacture printers and inks for architectural glass.

Durst

In 2014, family company Durst introduced its first inkjet system to print ceramic inks on architectural glass. The printer used inorganic inks (pigments) in the colors red, blue, green, yellow and black.

Durst also offers a sol-gel ink to be applied in their large printer. Furthermore the company sells a special printer for architectural glass, PV cells and a printer to manufacture automotive components.

Tecglass

In 2018, the Spanish Tecglass (part of the Fenzi Group) launched a production line for digital printing on large glass panes. Tecglass F Type F K series line accepts a maximum glass pane size of 1,199 by 3,012 millimeters in one pass and larger sizes in multiple passes. Tecglass printers contain six channels to print the standard colors and two open channels to print special ink formulations, such as magenta, metallics and etch effects.

According to Tecglass, their printheads don't need to be cleaned because of a high ink flow rate and an ink recirculating system. For a continuous production cycle, Tecglass offers an automatic drying system to optimize production performance.

Advances

The advance of digital inkjet for flat glass applications will pass through a substantial increase. Digital techniques offer a number of unlimited options to architects to integrate printed glass to office — and public buildings — at an affordable price.

Case Studies

In order of time and history, the following application examples are shown

1. Renovation of Asten's convent — Screen printing
2. Dutch Institute of Sound and Vision — Digital powder coating
3. Cardboard cathedral of New Zealand's Christchurch — Dip-Tech digital inkjet
4. Origami building at Paris — Dip-Tech digital inkjet

Renovation of Asten's Convent

Sister Blandine Delsing, the Mother Superior of the Franciscan Missionaries, in Asten, the Netherlands, described the renovations needed on their chapel: Heaters were positioned along the walls on two sides, causing visitors near them to become overheated and parishioners in the center of the chapel to be caught by an unpleasant cold trap.

In 2002, an architect was contracted to discuss the options. One of the solutions was to install underfloor heating to improve the heat distribution. The position of the pews was also changed: no more head-on but positioned around the communion table. Finally, a light problem needed solving. The solution was the creation of two oblong windows, symmetrically positioned relative to the communion table. The window opening was larger at the outside rather than the inside to playfully reinforce the light effect. Architect Branka Vuksanovic of Van Aken Architecten of Eindhoven, the Netherlands, called the overall result a "dynamic element in a static setting."

One of the recommendations was that the 6-by-1-meter glass panel should harmonize with the chapel's interior. The images had to relay a message without attracting too much attention. Visual artist Ellen Brouwers translated the recommendations into requirements. Based on the solar song of St. Francis, the Universe and the Covenant, the design was printed in a limited number of colors. The large sizes of the panes and the printed product's requirements made screen printing the only suitable transfer technique.

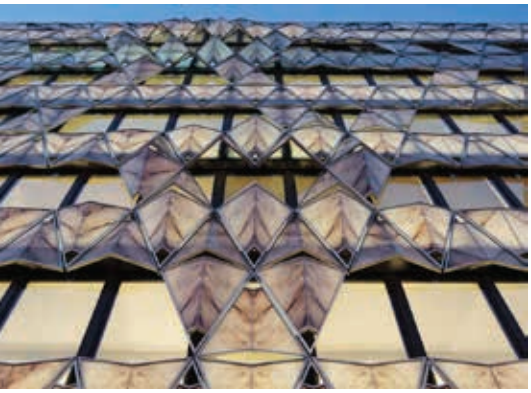
For the two panes, the printer used 10-millimeter-thick float glass and a 7-by-2.4-meter aluminum screen printing frame. He stretched a 68/55 fabric tensioned at 25 newtons/centimeter. Despite a profile size of 12 centimeters, this mesh tension created at both longest frame profiles a deflection in the middle of approximately 100 millimeters.

The direct emulsion was water-based, and the screen printer used water-friendly ceramic paste as well. The image was copied using a CTS technique, and was printed using halftones of 16 dots per centimeter.

The fourth print run was a rainbow, printed in one go on the glass by iris printing. Four glass paint colors, red, yellow, green and blue, were carefully positioned in front of the squeegee on the fabric, and more or less mixed as the squeegee traveled.

After printing, the printer dried using hot air and infrared at 180 degrees Celsius to remove the medium from the glass. In another kiln, the printer glass was tempered at approximately 700 degrees Celsius to meet the required chemical resistance specifications. This is just above the softening point of glass. A few seconds

Cardboard Cathedral at Christchurch.



Dip-Tec: Origami building at Paris

later, the glass pane was cooled down. The ceramic paint is now fused to the glass and becomes mechanical and chemical resistant.

After the renovation, there remained only four days to the official inauguration. The two panes, with the text "Pax et Bonum" (in English, "Peace and Goodness"), were directly transported to the chapel and placed into the window frame by a team of glaziers.

Dutch Institute for Sound and Vision

During the 1990s, the Dutch government decided to found a national institute to preserve and present the nation's audio visual heritage. The result was the Dutch Institute for Sound and Vision.

Designer Neutelings Riedijk preferred a vivid and a translucent façade that represented broadcast images and films.

The designers aimed to have glass panels in several vivid tints continuously changing color. To optimally use the color difference of the incident light, the designers created images in 3D-relief on the panels. The challenge was to cover the 5,000-square-meter façade with images of the Dutch Golden Coach and the twin towers in New York.

The colors were printed with a digital printer built specifically for this project. This RGB printer printed red, yellow and blue-colored glass powder.

One of the advantages of the digital printer, compared to screen printing, was that the image could be changed until just a short time before printing. During the firing process, these colors were fused to the glass substrate, changing the halftone's angle.

The 3D-relief was obtained by converting the digital image into graytones. The intensity of the graytones was determined by the depth of the molds. At a temperature of approximately 700 degrees Celsius, the glass softened and started to adapt to the milled shape of the mold.

The mix of several colors of the façade might cause an observation's confusion, resulting in a headache and dizziness. The visual observation by the eyes is not able to focus on a complex combination of colors.

Cardboard Cathedral of Christchurch, New Zealand

The original cathedral of Christchurch was seriously damaged during the earthquake of 2010. A second earthquake in 2011 damaged the special stained-glass panes. Architect Shigeru Ban designed this transitional cathedral, which was almost finished in 2013. The nickname of the cathedral was "Cardboard Cathedral," because of the exuberant use of cardboard tubes.

The New Zealand Glass specialist Metro Performance Glass produced the complete glass façade, a surface of 126 square meters. The design included 49 pieces of triangular panels of colored glass. Metro Performance Glass used inkjet to color the panes. Authentic pictures of the original glass panes enabled the production of the stained-glass panes. By varying the ink film's density, the company was able to smoothly reproduce the stained-glass effect.

Origami Building, Paris, France

The façade of the French Barclays bank headquarters derives from the Japanese art of origami. The building looks like folded marble pages, and the images were printed using inkjet in combination with ceramic inks.

The printed images were distributed over 962 panels. This project meant an innovation of the old, former building into a historical and luxury part of Paris. The visible modernizing had to harmonize with the surrounding buildings. Initially, the architects planned to use real marble for the façade, but accepted the idea to print digitally to control the structure and the aesthetic quality. This method also prevents the crystallization of extremely thin marble plates. The printed result is an amazing and complex pattern with a certain depth effect.

Located in the Netherlands, technical author Wim Zoomer has several published articles in screen printing and industrial technology magazines about flatbed and rotary screen printing technology for both graphic and industrial applications. He is the author of "Printing Flat Glass," a book about architectural glass decoration processes. Wim has been a consultant of the European Screen Printing Manufacturers Association (ESMA) and board advisor of the U.S. magazine, iSP (industrial + Specialty Printing). He is a member of the Academy of Screen and Digital Printing Technologies. Contact wimzoomer@planet.nl.