ITMA 2019 Digital Printing Innovation

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Introduction

First introduced at ITMA 1991, textile inkjet printers were a novelty coloration process marketed toward sampling and high-end short runs due to the low production speed of 10 m/hr. At ITMA 2019, nearly thirty years after this technology was first shown, textile ink jet printers reached speeds of 90 meters/min., making this technology highly competitive with rotary screen printing.

With speeds equaling and some instances surpassing rotary printers, textile ink jet printing holds a competitive advantage due to the elimination of the screen preparation process and the ability to hold print information in a digital format up until production. By eliminating the screen, and jetting the colorant ink jet printing allows for more flexibility in the print repeat size, enables an increase in the number of colors without increasing cost, provides capability for finer line detail, and reduces water and energy consumption. The fine line detail and increased number of colors can produce a near photographic image on the textile substrate, and the elimination of repeat sizes enables the print designer to engineer a print within the scale, shape, and optimal position of the textile product, enabling new product categories. However, the digital nature of ink jet printing is driving this technology as manufacturers are seeking ways to bring products to market faster in order to quickly respond to consumer demand.

Single Pass vs Scan-Type Printers

The increase of ink jet printer speed is attributed to changes in the configuration of the printhead system enabling an increase in nozzles. Scan-type printers operate by moving the printhead carriage back and forth across the substrate. Although considerably faster than when first introduced, the upper limit of scan-type printers is typically about 300 meters/hour, with the exception of the Mini Lario which can print up to 600 meters/hour. Single pass printers print at significantly higher speeds because the print head systems is arranged such that the fabric is fed under a fixed print unit, and the fabric moves under the printbars at a constant speed, building up the print image across the full width of the substrate by one stroke or pass of vertical image. In single pass printing, each print head station jets one color of Cyan, Magenta, Yellow, or Black (CMYK) with the capability to add up to four additional stations of colors such as Blue, Green, Violet, Grey, Red, or Orange. The footprint of single pass printers are considerably larger than scanning mode printers, however the speed of single pass printers often justifies the large square footage.

Single Pass Printers

At ITMA 2019 five single pass printers were displayed, with dozens installed globally. EFI Reggiani added the newest single pass printer, the 1.8-metre (71-inch) wide Reggiani BOLT, see figure 1. The Reggiani BOLT can achieve print speeds of 90 meters/minute at a 600 x 600 dots per inch

(dpi) resolution. The printhead has capability of variable drop sizes ranging from 5 to 30 picolitres. An innovative, optional, feature of the Bolt printer is that one or more integrated analogue printing stations can be included to be used for special effects such as a metallic pigment or as a pre-treatment device.

The Bolt printer is the fifth single pass printers to be shown at ITMA with four previously premiering at ITMA 2015. The four other single pass printers are MS/Dover Corporation's Lario, Konica Minolta's Nassenger SP-1, SPGPrints' Pike, and Atexco's Vega One. Information was provided for a six single pass printer from Swiss company Mouvent, name TBD, but the printer was not displayed and is not yet commercially available.
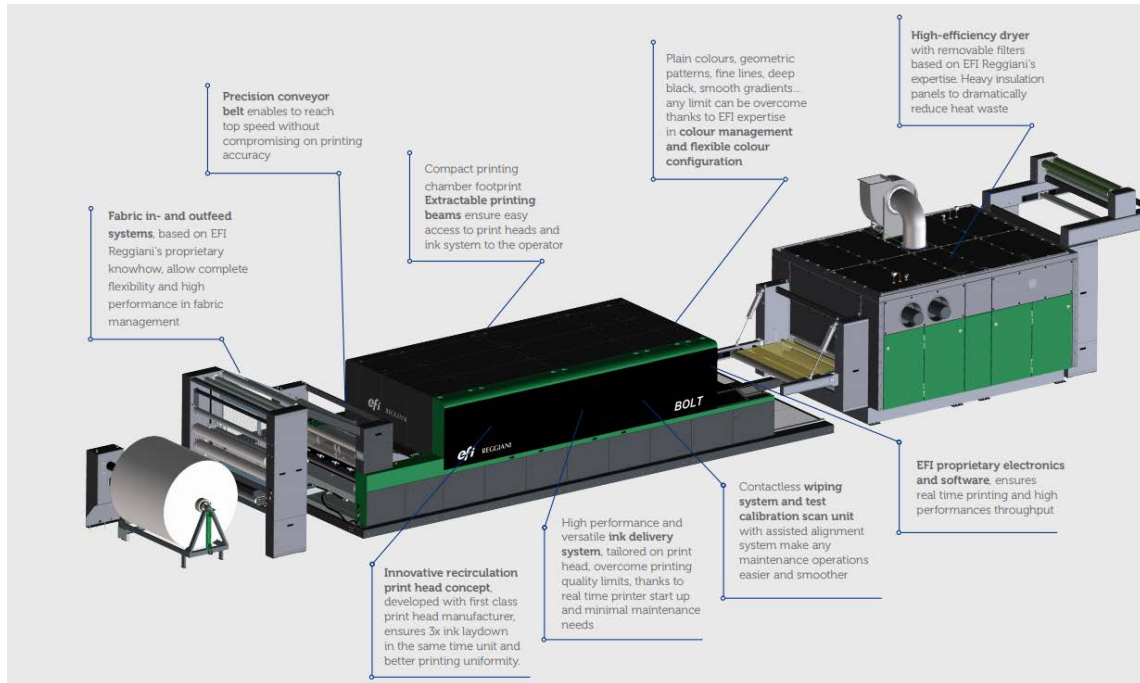

Figure 1. The Bolt Single Pass Printer from EFI Reggiani

MS Printing Solutions, a Dover company has 27 Larios installed worldwide; 24 of which are predominately used for direct to fabric printing, two for textile sublimation, and one for a non-textile application, see Table 1. The Lario has production print speeds of 75 meter/min for textile substrates (enabling 20,000 to 80,000 meters per day of printed fabric) and 120 meter/min for paper printing. MS showed an innovative in-line pre-treatment method for reactive inks that consisted of laying a foam onto the belt under the fabric, and then adding pressure to the top of fabric to force penetration of the pre-treatment.

Table 1. MS/Dover Corporation Installations of the Single Pass *Lario* Printer

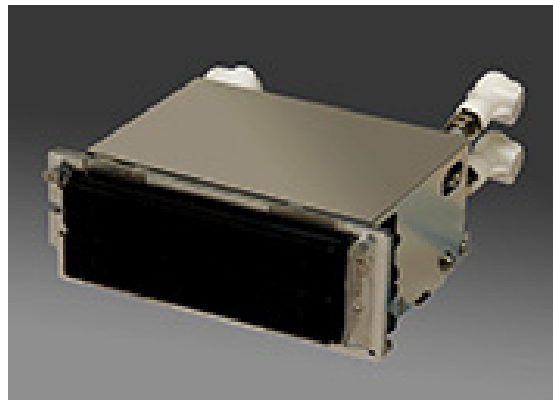| Region	Country	Type	Quantity
The Americas	Mexico	Textile Transfer	1
	Brazil	Direct to Textile	1
Asia	China	Direct to Textile	2
	India	Direct to Textile	1
	Indonesia	Direct to Textile	1
	Pakistan	Direct to Textile	1
Europe	Germany	Non-Textile	1
	Italy	Direct to Textile	10
		Textile Transfer	1
	Spain	Direct to Textile	3
	Turkey	Direct to Textile	5

Figure 2. Konica Minolta's Printhead for the Nassenger 10

Konica Minolta Nassenger SP-1has a total of 1,024 channel heads with independent-drive, and variable drop sizes from 6-30pl. The company developed their own printhead (Figure 2) which allows flexibility in the ink adjustment so that dark and light colors can be combined during the printing process. The printer can be configured for up to nine colors with capability to use reactive, disperse or acid dyes.

The Nassenger SP-1prints high definition prints (Figure 3.) with fairly good ink penetration from the face to back of the fabric. Another notable capability of this printer is an automatic printhead cleaning and empty nozzle detection systems to maintain stable production and reduced down time. To further decrease printer down time, the Nassenger SP-1is equipped with a fabric wrinkle-detection function and concave printhead nozzle surfaces to prevent transport problems. The Nassenger SP-1can achieve print speeds of 60 meters/min.

Figure 3. Nassenger SP-1Digital Fabric Prints

SPG Prints' Pike printer has printing speeds of 40 to 90 m/hr depending on the desired print quality. The Pike uses Fujifilm Diametrix's Samba print heads that incorporate a re-circulating ink channel system that prevents ink clogging. In addition the printhead maintains thermal stability for the duration of the print run, see Figure 4. This robust design enables SPG to provide 18 months of warranty on the print heads. A unique feature of the Pike is that it uses the Archer® technology, so that head print plates can be positioned three to six mm away from the substrate, greatly reducing the risk of a head strike. Typically, print heads are positioned two to three mm above the substrate, which poses a risk to the print head if the fabric is wrinkled. The Archer® technology can accurately jet across a much greater distance than other printheads while still achieving a native resolution of 1200 x 1200dpi. The Pike can be configured with six to nine printing stations, and each print station has a dedicated Archer® print bar containing 43 print heads with variable drop sizes from 2-10pl and a jetting frequency of 32 kHz.
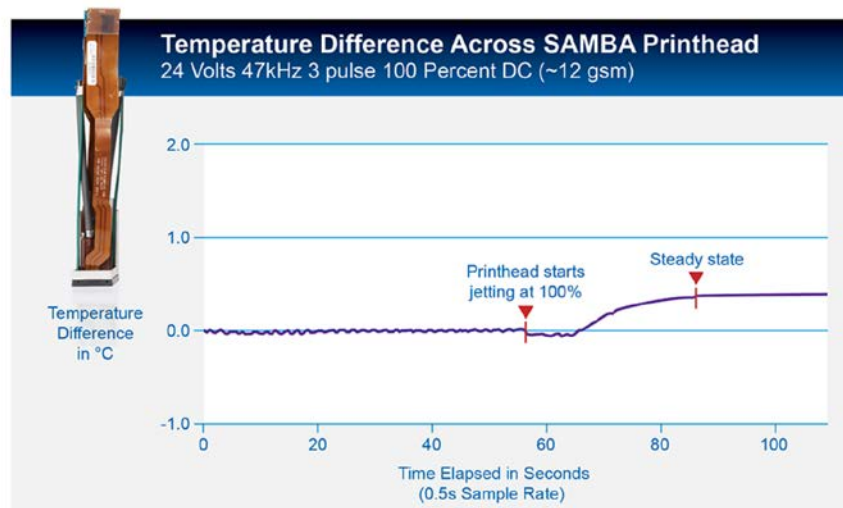

Figure 4. Temperature stability of Samba printhead

Atexco's single pass Vega One high speed printer can print 80 meters/min for production capacity of 8,000 to 10,000 meters per day. The high precision printhead nozzles can print with up to 1900ppi. The Vega One is also capable of printing one side of fabric, scanning for alignment, and then printing the reverse side, see Figure 5. This novel feature is suitable for double sided printing of products such as scarves and flags and may solve the issue of poor ink penetration that has proved problematic for ink jet prints.

Figure 5. Atexco's Vega One Double Sided Digitally Printed Scarf

Scan-Type Printers

While increased production speed of single pass printers was highlighted at ITMA 2019, so too was the refinement of scan-type printers. New to the specialty print market, Twine Solutions, premiered a machine for printing sewing thread on demand. Thread can be dyed in millions of colors immediately and on demand, creating unique colors, shades or even gradients. New to the textile inkjet printer market. HP, traditionally a manufacturer of printers for paper and sign and banner, showed the STITCH S Printer Series for disperse printing on both transfer paper and textile rolls, and KeraTex, inventors and pioneers of digital ceramic printing technology for floor tiles showed the Kerajet high speed digital textile printer.

Zimmer's Coloris

Zimmer Austria Inc., a global leader of production printers for textile and carpet finishing, showcased their pigment printing capability with the COLARIS.96-3400, a 3.4 meter wide digital inkjet printer that can be outfitted with up to 96 print heads. This flagship printer is suitable for textile applications and allows a capacity beyond 1,000 m²/hour. Zimmer demonstrated an inline drying system with a small footprint that used a unique infrared technology in combination with a vacuum suction system to cure the pigment. The Colaris series of printers can be used with a variety of colorants such as reactive, disperse, acid, pigment, and vat for printing lightweight to very heavyweight fabrics that require colorant penetration through the substrate

such as carpeting, towels, and plush or heavy automotive and home décor fabrics. Zimmer has several COLARIS pigment installations in Europe and Asia and the first unit in the US will be installed in November 2019. For the US market, Zimmer has focused on home décor and digital camouflage printing, thus the emphasis on pigment and vat colorants.

The Colaris series of scan type printers range from 2.2 to 5.2 meters print width while the COLARIS-NF is a single-pass printer for narrow fabrics. In-line pre-and-post treatments systems can be added to improve print quality and increase ink penetration. The MAGNOROLL GMA and CHROMOJET (CHR-DPT) are inline pre-treatment applicators, the first for lighter to medium weight fabrics and the second for medium to heavy substrates such as terry towels, flocked fabrics, velour, and even carpet. The SUPRAPRESS press station can be added as an increased penetration and equalization device to ensure maximum penetration on products like carpets or PES blankets. The SUPRAFIX SHS is a combined, horizontal color fixation system using optionally saturated steam, superheated steam or hot air according to the amount of ink being used. The fixation activity is controlled by a flow through steam/hot air stream and ensures the highest penetration, ink fixation and drying in a single pass at the shortest possible time.

The Colaris printers are equipped with Fujjifilm Dimatex's StarFireTM SG1024 compact industrial printheads. The StarFireTM SG1024 printhead is available in four models for Colaris printers, each with varying drop size capability;1) the X-Small printhead is for very light fabrics (< 150 gsm) or when excellent definition, fine contours or super smooth gradations are required with drop sizes from 7 to 21 picoliters 2) the Small or SA model is intended for printing of light and medium weight home decor, apparel, and flag substrates that can achieve ink penetration with drop sizes ranging from 12 to 35 picoliters; 3) the medium or MA printhead has capability of 30-75 pico liter drops and is best suited for medium weight carpets velours, terry cloth and low to medium plush piles; and 4) large or LA model printhead is capable of 75 to 180 pico liters drop sizes for ink penetration of voluminous substrates such as heavier weight carpet, furs, and plush blankets. If both fine line definition and penetration is needed then there are two options: choose the small printhead size (e.g. SA instead of MA) and print with higher resolution to achieve more ink laydown, or using a medium or large printhead, operate the head only using the smallest drop size. (drop size 1 instead of 1+2+3) to get the fine contours.

KERAtex MP

Keratex are inventors and pioneers of digital ceramic printing technology for floor tiles, and they now bring this industrial printhead technology to textiles. The Keratex series are available in three widths; the MP 3400 has print widths up to 3.4 meters, the Keratex MP 2400 has print widths up 2.4 meters, and the Keratex MP 1800 has print width up to 1.8 meters. Regardless of the model, all of the Kerajet series printers are fully configurable for up to 10 colors of any water based dyes or pigments colorants, up to eight printheads, and have open platforms for colorant and RIP, see Figure 6. Kerajet printers use the StarFireTM 1024 printhead, developed by Fujjifilm Dimatex.

Figure 6. Kerajet Digital Printer

HP Stitch

HP Corporation debuted the Stitch series of printers with native 1200 dpi printhead resolution for vivid colors and deep blacks. This low maintenance printer can print unattended at production speeds of up to 220 meters^2/hour. HP is one of only a few printer manufacturers that also own and operate printhead factories and they've taken advantage of their R&D capability to bring a series of printers to the market that they use thermal rather than the piezoelectric printheads. With a piezoelectric printhead an electric charge is applied to the piezo crystal causing a vibration that forces ink out of the printhead nozzle. With thermal printheads the ink is rapidly heated, generating bubbles that expel the ink through a nozzle. The vast majority of textile ink printers on the market use piezoelectric printheads. Generally thermal printheads are less expensive, but in the past, there was compatibility issues with some types of colorant. HP was able to develop a disperse ink that was suitable for a

thermal printhead. In addition, HP thermal printheads enable more nozzles, up to four times as many, therefore when a nozzle is out, others can fill the gap. Unlike piezoelectric which is sensitive to heat, the thermal printhead allows for a drying to occur in the print zone enabling the ink to dry immediately upon deposition on the paper allowing for lighter weight papers for sublimation.

The Stitch S1000 can print up to 3.2 meters at speeds of 10 meters/hour for a six pass, highest quality print and up to 18.7 meters/hour at maximum speed. A spectrophotometer is built into the printer to enable online calibration across multiple printers, regardless of the location of the printers. The Stitch S1000 is also equipped with an optical media advanced system (OMAS) with a photo capture capability to ensure optimal medium feed throughout the print run.
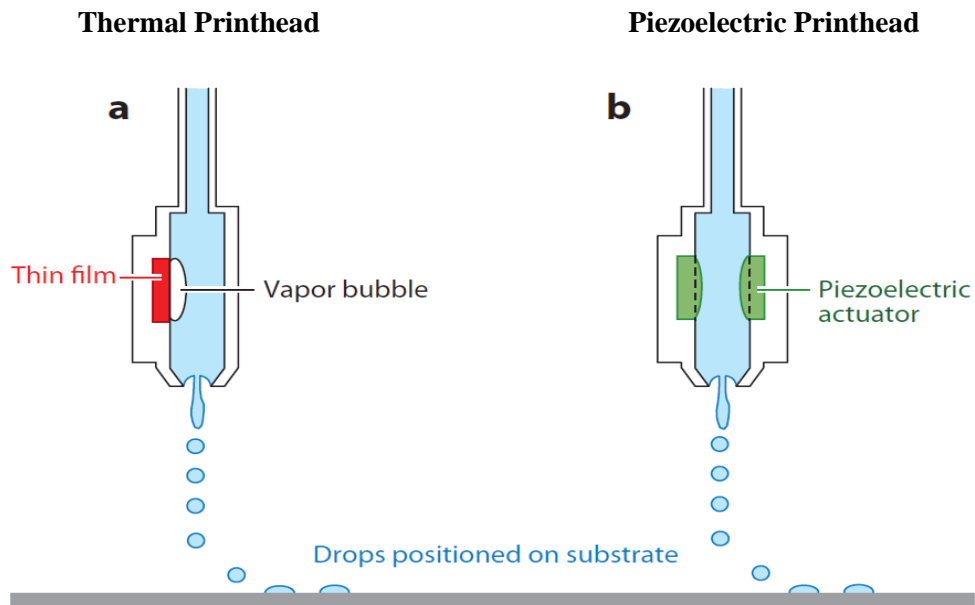
Thermal Printhead   **Piezoelectric Printhead**

Figure 7. Thermal vs Piezoelectric Printheads

Summary

Single pass printers offer speeds and prices that are competitive with rotary screen printing, however scan-type printers are still the predominate type of textile ink jet printer because the lower cost allows printing service providers to install more printers, with the flexibility of varying colorant type or printer manufacturer within their factories. Scan type printers are also suitable for companies starting up an ink jet printing division who don't want a large capital investment before learning how to optimally implement the new technology into their existing manufacturing process. And of course, the lower cost of these printers still meet the needs of sampling, prototyping and specialty print markets. Research and development continues in machine technologies such as fabric handling, print head capability and robustness, quality control mechanisms for nozzle failure and fabric wrinkle detector systems; and chemistry developments in colorant and pre-treatment. For successful implementation of this technology still needed is optimization of the printing supply chain for process, water, energy, and price reduction.