ITMA 2003 Review: Textile Printing

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ABSTRACT

This paper reviews the new developments shown at ITMA '03 in the textile printing area. New equipment and techniques were exhibited for flat screen printing, rotary screen printing, and transfer printing. However, the area of digital ink jet textile printing appeared to generate the most overall interest both from the exhibitors’, as well as, the attendees’ point of view. Most people interested in the textile printing area seemed to feel that ITMA ’03 was highly successful.

Keywords: Textile printing, flat screen printing, rotary screen printing, transfer printing, digital ink jet printing

Textile printing is the area of textile processing used for applying color in a localized design or pattern to a textile material, normally fabric. Depending on the fiber composition and the construction of the fabric to be printed, as well as the proper selection of dyes or pigments, the printed patterns can exhibit good to excellent colorfastness. From a practical point of view, textile printing is the process which incorporates artistic design, engineering and chemical technology to produce unique patterns which can then be accurately repeated on large volumes of fabric.

In traditional textile printing, the colored images on the fabrics are produced by using textile print pastes which consist of highly concentrated thickened solutions of textile dyes or pigments. Unfortunately, as a consequence, the use of these print pastes can also lead to intensely colored waste products. Environmental issues are a major concern to most textile printers. The standard methods for textile printing are flat-bed screen, rotary screen and engraved copper roller. These methods are normally referred to as wet printing techniques because they all incorporate viscous print paste solutions for development of the color designs on the fabric.

A fourth major fabric printing method is known as transfer printing. This technique involves initially printing the design onto paper, then subsequently transferring the pattern from the paper onto a textile material. The most successful of this type of printing uses disperse dyes which can be sublimed, printing them onto paper, then transferring this printed image onto fabric by heating the paper above the sublimation temperature of the dyes while it is in direct contact with the textile material. This technique is limited to being used with only fibers which will readily accept the sublimed disperse dyes, most notably polyester, nylon and triacetate. There are also well-used methods which employ pigment formulations printed onto release
paper. This type of printed paper is also heated while in direct contact with the textile material. The heat causes the binder of the pigment matrix to release from the paper and subsequently fix onto textile. This technique is often used for printing garments and fabrics. These methods have the distinct advantage of being dry printing processes and do not generate waste effluent.

Digital ink jet printing of flat textile fabrics was shown at ITMA '95. The Stork machine called the Fashion Jet created tremendous interest. This interest in digital printing continues today with tremendous improvements in computer capabilities, software and digital design developments, new digital printing dyes and fabric pretreatments. However, certain hardware circumstances, especially with digital printer head technology, limit the output productivity of this printing method compared to other printing techniques. Digital printing also generates minimal colored wastewater from the overall printing process.

At present, the two most important methods for printing high volumes of fabric for today’s diverse market are rotary and flat-bed screen printing. Although specific production figures are difficult to obtain, it has been reported that 80% of the total textile printed fabric output employs one of these two techniques. Furthermore, it has also been reported that rotary screenprinting accounts for as much as 65% of the overall total of printed goods. The amount of printed goods resulting from the remaining printing techniques still represents large quantities of textile materials. The ITMA '03 exhibited the continued refinement of traditional printing methods and continued technological development of digital ink jet. Overall, the development in textile printing shown at ITMA '03 can be described as a continuing evolution of many of the trends which were seen at ITMA '99, ITMA '95 and ITMA '91. In general, the digital printing area showed the most innovative developments along with having the largest number of exhibitors.

The trends in textile printing exhibited at the ITMA '03 show include:

- Continued improvement of microprocessor control systems for printing machines of all types including flat-bed screen, rotary screen, transfer printing calenders, and digital ink jet printers. As computers have gotten faster, more capable and cheaper, these control systems have shown remarkable improvement.

- In the specific case of digital printing, CAD systems along with specific software were exhibited which produced designs with fantastic detail and image resolution.

- Many different refinements were exhibited, especially for screen printing, which lead to increased printing output, minimization of set-up times, higher printing speeds, more precise print pattern control and minimization of downtime for pattern changeover and machinery cleaning. New automated on-table and off-table screen washing systems were shown which reportedly reduced downtimes to under 10 minutes between pattern changeover.

- Many machines exhibited improvement in mechanical design. In some cases,
hydraulic drives were replaced by electronic drive systems to increase printing speeds with subsequent reduced maintenance costs.

- Both rotary screen and flat-bed screen machines were exhibited with highly compact print tables in order to conserve expensive processing floor space.

- Refinements in color mixing and dispensing systems, as well as print paste recovery and reuse, were shown by a number of manufacturers. The minimization of concentrated print paste released as waste effluent has tremendous positive environmental impact.

- Improved systems for filmless screen engraving, were exhibited. Reportedly, these systems produce excellent image resolution with increased accuracy. Additionally, these systems engrave screens at a higher productivity rate, using less labor and thus reducing the overall cost of the engraving process.

- Computer controlled systems were shown by a number of manufacturers for the integration of the screen printing process. These systems generally include CAD digital screen and pattern design, automated screen engraving, automated print paste mixing and dispensing, print paste recovery and reuse along with semi-automatic or fully automatic print table, belt and screen washing systems. All these functions are monitored and to some extent controlled by a central computer for maximization of printing efficiency while minimizing downtime.

- Numerous types of improvements in digital printing were exhibited at ITMA '03. Total integration of the process were promoted by several suppliers. In these cases, the manufacturer provides the CAD digital design system along with its software, the digital ink jet printing hardware, the digital printing inks, and the pretreated fabric ready to be printed.

One supplier of textile printing equipment referred to ITMA '03 as a “truly remarkable fair within the International Textile Machinery Industry.” This statement is especially encouraging in respect to the fact that many in the textile community had very low expectations for the exhibition prior to its opening. With this quote in mind, the following is a review of some of the more noteworthy developments in the textile printing area displayed at ITMA '03.

**Flat Screen Printing**

One of the most modern and interesting of the flat (bed) screen machines shown was the Buser F8 Electric. (Fig. 1)
This machine features replacement of the typical hydraulic main drive with the use of an electronic main drive by using an AC-servomotor. This innovation allows for printing speeds of up to 28.5 meters per minute with a one-meter repeat. Additionally, this machine features pneumatic control of the up and down movement of the squeegees which reportedly drastically reduces wear on critical parts and decreases the need for maintenance. This machine also features squeegees which are driven by a variable speed AC motor and can be adjusted independently. The unit can be used for either knit or woven fabrics due to the tensionless feeding and transport of cloth through the printing area. The fabric is aligned on the print blanket by photocell for maximum print accuracy. A number of other manufacturers exhibited machines with similar features including the Gali Mitex 126 and the MS Machine MS 2000F. Although not displayed at the show, the Ichinose 7000 incorporates many of the same features. Zimmer exhibited its Magnoprint Trendline flat screen machine with speeds reportedly up to 35 meters per minute. It should be noted that these machines incorporate computer controls wherever required.

A number of manufacturers exhibited flat screen machines for the printing of garments, specifically tee-shirts, sweatshirts, etc. These machines are highly automated such that only two operators might be required, one to load the garment on the print table and one to off-load the printed garment and place it on the dryer belt. These machines exhibit a number of features including:

- electric squeegee drive systems
- automated and self-leveling squeegee pressure adjustments for uniform print paste distribution
- automatic flash cure systems attached to the print pallets
- quick push button pallet change
- individual push button lock/unlock of screens
- motorized automatic screen positioning incorporated with digital design memory
control keypads at every print station with all main machine functions

touch screen user-friendly computerized main machine controls often including diagnostic fault detection systems

Machines exhibited which include many of these features are illustrated by the MHM Synchroprint 3000 and the M & R Premiere. (Fig. 2)

These units are offered in various sizes up to 26 colors. Depending on design complexity and other production factors, output capacities have been reported from 700 to 1400 garments per hour.

Rotary Screen Printing

Rotary screen printing is the dominant high productivity printing method for most fabric constructions in the world today. Stork Print B.V. celebrated the 40th anniversary of its 1963 introduction of rotary screen printing by introducing the new RD 8 (Fig. 3) rotary screen machine. The center of attraction for the Zimmer-Austria booth was the display of the first original rotary screen print machine invented and built by Peter Zimmer in 1955. Beside this historic exhibit was shown the latest Rotascreen Trendline V machine. Other companies exhibiting rotary screen machines include Buser with its Rotomac 6 (Fig. 4) Reggiani with its latest version of the Unica, Harish Enterprise with its model ND4 and the MS 2000R from MS Macchine. (Fig. 5)
In general, these machines exhibit very high technology while, at the same time, they can be very versatile so that a wide variety of customer requirements can be met. They offer a variety of features including:

- compact, modular design for versatility
- machines with 4 to 36 color capability
- individual drive of each printing position for greater control and accuracy
- electronic linkage and synchronization between the printing positions and the print blanket
- printing screens driven from both sides
- blade and/or roller squeegee systems available
- electrical adjustment of blade squeegee angle for maximum color penetration with minimal wear on parts
- automatic presetting using computerized data including motorized repeat settings
- uniform and optimized glue application using water
soluble glue or thermoplastic adhesives
- wide variety of standard printing widths
- tensionless cloth feed and fabric transport through the machine to accommodate wide varieties of fabric constructions
- highly efficient blanket, squeegee, screen and pump washing systems for minimal downtime and maximum printing efficiency
- print paste recovery and reuse systems
- computerized machine controls with highly sophisticated software and data storage systems

Today’s rotary screen machine offers more sophistication, flexibility and ease of operation than ever before.

A number of exhibitors represented companies that supply auxiliary material or services to the screen printing industry. Several exhibits dealt with alternative methods of screen engraving for both flat and rotary screens. These methods are known as inkjet or wax jet. Both methods are similar in that they use a digital printer to apply either opaque black ink or molten black wax positive image directly onto an unexposed precoated the screen. The CAD system driving the printer is used to determine image color separation and repeat size. Once the image is formed on each screen, the screen is exposed to light and the ink or wax is subsequently removed. The major difference between the two methods is that the inkjet method uses standard industrial print heads with lower spare parts cost, easier handling and lower maintenance. However, the image resolution is reported at 720 dpi compared to 914 dpi or 1019 dpi for wax jet. Overall, these methods are reported to be time and cost-saving alternatives to standard filmplotters or laser engravers. A reported typical time for engraving a screen with film is approximately 45 minutes. For the same design employing a laser engraver, the typical time is approximately 40 minutes. The typical time for the wax jet/inkjet method is reported at 10-12 minutes. Additionally, machinery cost for these methods are much lower than with a typical laser engraver. Machines exhibited using these techniques included the CST flat and rotary inkjet/wax jet (Fig. 6) or the Lüscher Swiss CTS Jet Screen (Fig. 7) and the Kaiyuan flat or rotary waxjet.
The Stork NovaScreen has been the standard in the rotary screen printing industry. At ITMA '03, Stork introduced a series of high resolution screens with large open area. These screens, the 130 SP, 160 SP and 190 SP, are intended for special effects or printing designs which include special materials such as metals, particulate materials or even sand. A key advantage of these special screens is the ability to resist blocking or clogging problems caused by unusual materials. However, many companies exhibited rotary screens for textile printing at ITMA '03. These exhibitors included
Nickelmesh S.A., Saxon Screens GmbH., Shony Technology, and Karme Screens. These various manufacturers give the rotary screen printer a wide choice of screen materials with which to work.

As mentioned earlier, several companies exhibited rotary screen cleaning systems. A unique system was shown by Technijet. (Fig. 8) They exhibited a patented automatic magazine type rotary screen washing system. Up to 20 individual rotary screens are loaded into the machine and each screen is cleaned individually within a time of less than two minutes per screen. The machine has the capability to clean with water or organic solvent. All operation is fully computer controlled. The washing mechanism employs patented spray nozzle technology for minimum screen damage, maximum cleaning efficiency and reported water-consumption savings up to 75% compared to conventional systems. This low water system also greatly reduces negative environmental impact from waste effluent. Additionally, there is minimum operator involvement. The operator loads dirty screens and removes clean screens. This machine has the potential to increase printing production because the printer can be running new production while the previously used screens are being cleaned.

An additional patented device exhibited by Technijet was the Roto-Vac lint and dust removal system. The system combines various technologies from other industries to ensure efficient and effective removal of lint, strings, loose fiber and dust from pre-printed fabric. The system can be used at the entry end of the printing machine or in the first rotary screen position on the machine. The system employs a roller coated with a specially formulated adhesive. The adhesive roller is continually cleaned of debris that is carried away by a self-contained cleaning system. This machine has shown excellent consistent results for the rotary screen printer. A variety of other exhibitors, including some printing machine manufacturers exhibited off machine screen and barrel cleaning equipment.

Color mixing and dispensing equipment for textile printing was shown by numerous manufacturers. The improvement in control systems, measurement and weighing devices and the wide range of pump technologies available have made
these systems more dependable and capable. Impressive systems were exhibited by Color Service, Orintex (Fig. 9), Tecnorama, and Kidd & Zigrino.

**Fig. 9 Orintex System**

**Transfer Printing**

Transfer printing is a well-proven technology that has been a major player in the textile printing industry since the mid 1970’s. (Fig. 10)

**Fig. 10 Transfer Printing Schematic**

The key issues with transfer printing have been heating control, printing width, and printing speed along with the initial cost of the transfer paper. A number of manufacturers exhibited transfer calenders with improved microprocessor controls, larger cylinders for increased printing speeds and wider printing widths. In general, as the paper width increases, the cost of the paper also increases. A unique approach exhibited by Klieverik Heli was the Twin Transfer Calender (TTC). With this machine, two relatively inexpensive narrow strips of transfer paper are aligned and transfer simultaneously to give a wide printed fabric. The obvious advantage of this system is the use of the cheaper narrow transfer paper. Numerous other manufacturers exhibited modern transfer calenders including Fontanet, Kuesters, Monti Antonio and Bizmak.

Klieverik Heli also promoted a technique that was proposed at ITMA ’95 with a different company but now appears to be refined. This technique is known as the Cotton Art system. This method uses high quality transfer paper printed with reactive dyes transferred onto cotton or rayon fabrics. It is a process which is a combination of transfer printing and the cold pad batch process. (Fig. 11)
The general process involves the wetting of the fabric in the chemical pad, the transfer of the design under pressure from the paper onto the fabric, winding up of the fabric, and fixation of the transfer using cold pad batch process, incorporating plastic foil. This method gives near photographic images on cotton and rayon with reactive dyes.

**Digital Printing**

The idea of digital textile printing has been considered and worked with for many years. The use of the carpet inkjet printing machines such as the Zimmer Chromatron and the Milliken Millitron began in the early 1970’s. The first true inkjet printer for fabric was exhibited by Stork in 1991. The TruColor TCP2500 was designed mainly as a sampling machine using a rectangular fabric swatch. At ITMA ’95 Stork introduced the Fashion Jet which could digitally print continuous rolls of fabric. With fast paced developments in microprocessor capabilities, the success of CAD systems in areas such as apparel design and manufacturing, and the idea of near limitless design possibilities, digital textile printing has been of keen interest to many manufacturers. However, as recently as ITMA ’99, limitations of textile substrate transport systems, printing ink technologies and cost, printhead mechanisms and fabric pretreatment and post treatment cost made digital textile printing only viable for sampling or for only the highest value and most exclusive end uses.

Many manufacturers believe that ITMA ’03 marked the beginning of the first major commercial advance in textile digital printing since its introduction in 1991. At this show a new generation of much higher output, higher resolution printing heads were shown, incorporating much more sophisticated textile material handling systems allowing a wide variety of fabrics to be printed. Digital printing inks are now available for most textile substrates with improved flow and fastness properties. These inks are also available from a wide variety of manufacturers. These new printers are claimed to be economically competitive on fabric run lengths of up to 1,000 square meters. Overall, digital printing machine suppliers hope to expand the digital market from its current 0.1% of total print fabric output to nearly 10% of that production worldwide.

Additionally, adding to the optimism for digital textile printing are the further developments of fabric preparation and finishing systems directly designed for digital prints. Also, the number and variety of companies offering digital design, virtual fabrics, and software control systems can be almost overwhelming. Generally, ITMA
'03 can be viewed as the advent of digital inkjet printing aimed at use in actual production volumes of textile goods. The DuPont Artistri 2020 (Fig. 12) was exhibited as a fully integrated production capable digital printer for both apparel and home furnishing.

The printer itself was built in conjunction with Ichinose of Japan. The machine features advanced piezo-electric printing heads with resolution as high as 360-720 dpi with productivity of 30 to 50 square meters per hour. Additionally, the machine has a self-contained ink delivery system, DuPont Artistri printing inks, an adhesive print blanket for fabric transport, an in-line fabric dryer and an adjustable printhead carriage height. DuPont also supplies specific pretreatment and post-treatment instructions for various textile materials.

Reggiani showcased its DReAM Machine (Fig. 13). This machine was developed in conjunction with Ciba Specialty Chemicals.
This machine features two unique innovations. This first is that it combines the high technology of Regianni’s well-proven textile substrate conveying systems, holding the fabric in position very accurately, with Aprion’s Majic six color inkjet heads. The second innovation is that it uses completely new printing inks developed by Ciba Specialty Chemicals. These inks include reactive dyes, acid dyes, disperse dyes and pigments. This machine reportedly achieves printing speeds of up to 150 square meters per hour, with designs suitable for both apparel and home furnishings.

Stork in cooperation with Lectra and Rimslow offered the Sapphire (Fig. 14) totally integrated digital printing system.

![Stork Sapphire Digital Printing System](image)

This system offers design software from Lectra, the digital printing hardware from Stork and the Steam-X from Rimslow for aftertreatment of the prints which can be synchronized with the printing of the Sapphire. Stork also provides the printing inks, as well as the pretreated fabric. This digital printer uses piezo electric printheads and can print fabric up to 32 square meters per hour. It also has the ability to handle a wide variety of fabric types including knits and wovens.

There were a great number of excellent digital inkjet printers exhibited from a wide variety of companies. These included the Chromotex digital printer from Zimmer, the Mona Lisa from Robustelli which was developed in conjunction with Seiko Epson Corp., the d*gen 740 from South Korea, the Mimaki Textile Jet and the Texjet 254 digital textile printing system from Color Wings. However, these are just a few of the many digital printers exhibited at the show.

A very interesting, unique image development system was also shown by several manufacturers. These systems use a tuned laser to carefully burn an image into the surface of a fabric. This works extremely well on pile fabrics or denim. (Fig. 15) It can also be used to create a sanded or worn appearance on denim fabrics. (Fig. 16)
Care must be taken to control the penetration of the laser or the fabric will be completely cut. Also fabrics must be afterwashed to remove dust which is formed during the laser process. Companies exhibiting this type of processing included GFK, Laser System Technology (LST), Tonello, and Technoblast.

Overall, the ITMA '03 exhibition was much more of a success than many of the manufacturers anticipated. It was well attended and many new ideas were demonstrated. In the printing area, the developments shown were mainly refinement and improvement of previous ideas. However, ITMA '03 may be remembered in the future as the real beginning of digital textile printing as a viable production process. Only time will tell if these new machines and systems will prove to be textile production workhorses.