

# Bubble-Jet (BJ) Textile Printing System

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## Abstract

The BJ Textile Printing System<sup>1</sup> is a full color screenless printing system, with the adoption of BJ printing. It also takes in Canon's original color image processing technology. Thus, it can omit the complex screen plate manufacturing process, which requires skills. Therefore, it can realize quick response and small lot production. Furthermore, emission of waste water can be much decreased compared to the conventional system. High quality print is realized by this system with a printing speed of 1m/min., and can reproduce 16.7 million colors with a resolution of 360 dpi. The system has been developed into a printing machine suited for real production. The present paper will describe on the new print head cleaning technology which has been installed in the textile printing system.

## Introduction

### Current Situation

As the span of current fashion trend is becoming shorter and shorter, and individual tastes are diversifying more and more, the textile printing industry must change flexibly to respond to such needs. In other words, it must realize quick response and small lot production. The conventional type of textile printing system, like the screen printing system, requires long lead time due to the fact that it consists of complex processes requiring skills. Mostly high volume production is only acceptable in order to be profitable, so massive stocks of raw materials and printed textiles, including huge number of screen plates has to be stocked. Furthermore, since it emits huge volume of waste water, it is not a very desirable method against the environment.

### Solutions to the Current Situation

The BJ Textile Printing System is simple and screenless, it can adjust flexibly to quick response and small lot production will give full play to the creativity of designing because there are no limitations in creating textile designs like in the conventional printing system, and by the application of direct image data transfer from computers, designs can be created easily on computers, too. It can also solve other problems that the conventional printing system had, like reducing huge waste water emission and the volume of stocks to hold.

### History of the BJ Textile Printing System

A collaboration began between Canon and Kanebo, one of the oldest textile manufacturer, in 1990. We completed developing the system for test marketing in 1993,

and Kanebo has been test marketing the textiles printed with this machine since then.

This new BJ Textile Printing System made for real production will be described in the following chapters.

## BJ Textile Printing System

### Appearance and Specifications

Figure 1 shows the appearance of the system.

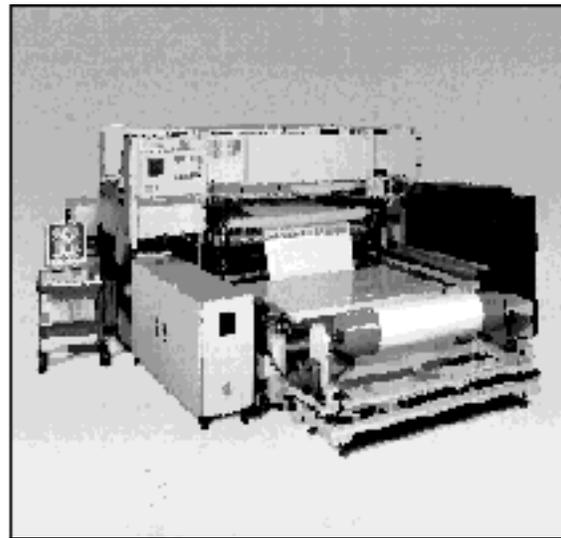


Figure 1. Appearance of the system

It is quite compact as a textile printing system, with the following specifications.

6. Machine size:
  - Width : 3.8 meters
  - Depth : 6.4 meters
  - Height : 1.7 meters
7. Machine weight
  - Weight: About 7 tons
8. Maximum Print size:
  - Continuous printing of fabric with a maximum width of 1.65 meters.
9. Print speed:
  - Print speed is 1 m/min. This is realized by the adoption of bi-directional printing, with long-size print head, which is 9.6 cm wide and has 1360 nozzles. There are 2 lines of 8 print heads for 8 ink stations, which makes a total of 16 print heads.
10. Ink station:
  - There are 8 ink stations. A maximum of 8 colors of ink is printable at once.

**The Benefits of Applying BJ Printing**

This non-impact printing method enables us to print on various materials. Compared to printing methods like thermal printing and electrostatic printing, the material doesn't have to touch the print head directly, which means there are few restrictions of material type to print on, and can even print on rough or fluffy surface fabrics.

It also applies drop-on-demand printing method which helps energy savings. Unlike continuous ink jet printers, it is unnecessary to dispose or recycle the collected ink.

**The Bubble-Jet Ink for Textile Printing**

Almost all kinds of materials such as silk, cotton, linen, rayon, nylon, and wool can be printed with the system using reactive and acid dye ink. Recently, we have also developed ink for polyester fabric, which is disperse dye ink. In other words, it can print on all of the major types of materials used in the fashion industry.

Furthermore, as in Table 1, Special Color Ink and Light Color Ink (low concentration dye ink) is prepared to reproduce color gamut which is difficult to reproduce with the process colors; cyan, magenta, and yellow. Special Color Ink is used to express more vivid colors and Light Color Ink for smoother gradation of colors.

**Table 1. BJ Ink in a Full Line-up**

Ink Type	Applied Materials	Basic Colors		Light Colors
Reactive Dye	Cotton Silk Linen Rayon	Black  Cyan Magenta  Yellow	Blue	Light Cyan  Light Magenta
			Acid Dye	
Disperse Dye	Polyester		Blue Purple	

**Printing Process of this System**

The printing process of this system is very simple. There are only 3 main steps to go through as shown in Figure 2: Fabric pretreatment, digital image processing, and BJ printing. Post-treatment like color fixing, washing and drying is necessary in the same way as in the conventional printing system.

In order to obtain high quality printing, we particularly developed special pretreatment to suit to each type of fabric material. They are used to prevent ink bleeding and will reproduce high color value using the BJ ink with low viscosity.

**Features of this System**

**Quick Response and Small Lot Production**

Quick response is realized by shortened lead time, which is the process from image data input until the end of sample printing. It takes only 3 days to be ready for real printing, which would take about 1.5 months with the conventional printing system. Only 2 weeks is necessary for the whole process against 2 months by conventional print-

ing, which means lead time is shortened to 1/4. Figure 3 shows the comparison between the process of BJ and conventional printing.

Our original image processing technology made it possible to omit the complex processes requiring skills; picture tracing for screens and mixing individual color pastes for screen printing. The usage of computers realizes the flexibility of design modification, so changing the layout of design patterns, making changes in colors, etc. can be done freely. Therefore, more creative designs can be printed on textiles with our BJ textile printing system.

Since there is no need for manufacturing screen plates, as in the conventional textile printing, we can handle small lot prints in the length of 10 m in affordable prices, or even prints printed piece by piece.

Transferring image data between computers for designing and printing is also quick and flexible. In the near future, data transfer will be directly made between client and designers, designers and textile printers through digital network. This will enforce the quick response system even more and will satisfy the various needs of our customers.

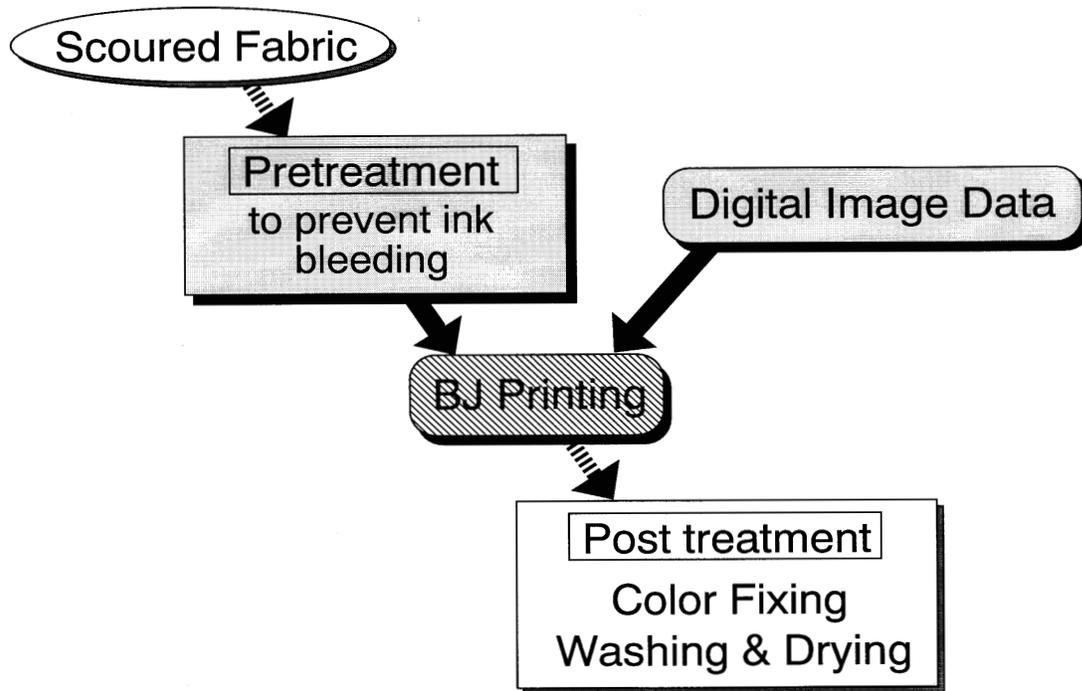


Figure 2. Process flow of the system

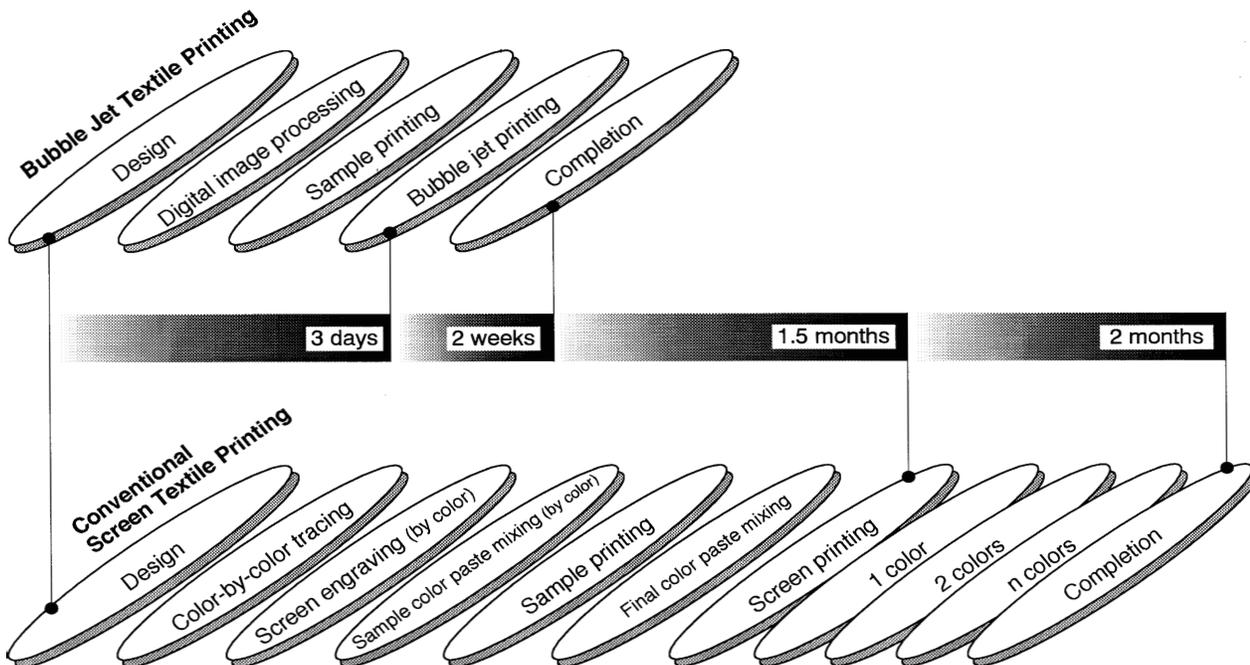


Figure 3. Quick Response

**Enlargement of Design Field**

It is completely free from the limitations of color numbers or registration discrepancy of screen plates with this system. Because smooth gradation of colors can be reproduced with this system, the original design can be printed

as it is with high image quality. As a result, it has created a new world of design field such as designs found in oil-paintings and photographic pictures, which require delicate expression of its textures.

The following features of this system supports the capability of expressing those details. A full color printer with an image resolution of 360 dpi, an accuracy of less than 0.1 mm in details, and an ink dot overlapping preciseness of 0.04 mm tolerance, which can reproduce 16.7 million colors in 256 gradations.

### Clean Production System

Waste water emission is only 1/10 of the conventional printing system. It is achieved by the adoption of the ink jet technology, which is drop-on-demand printing, and our special pretreatment technology. Most of the dye will fix to the fabric, and will not pollute the water. In other words, the burden for waste water treatment will be much decreased. A clear difference can be seen if it is compared with the conventional printing system.

A clean working environment can also be realized with this system. Dirty work like color paste mixing, screen plate cleaning, and screen plate changing, does not occur in our textile printing system, and can change the working environment clean as in an office room.

## New Print Head Cleaning System

### The Cleaning Process for the Print Head

As stated above, we have been trying to develop our system for real production. Stabilization of ink ejection in continuous printing of wide size fabrics was the most important technology to realize this.

When the BJ Textile Printing System prints 1.65 m wide fabrics continuously, ink mist will easily solidify and clog on the nozzles because it applies high concentrated dye ink compared to office printers to obtain higher color value. Fluff from fabrics will also adhere on the surface of the print head quite easily. This will lead to non-ejection of ink droplets from nozzles, which is a serious problem.

The cleaning system used in a BJ office printer was experimented on the printing system. As a result, it was difficult to wipe off ink mist from the surface completely. This cleaning system was not suited to wipe off high concentrated ink mist as well as fluff of the fabric with a blade mainly made of synthetic resin. So even after just a few meters of printing conducted, non-ejection of ink droplet occurred quite casually. Figure 4 shows a picture of the surface of the print head after the cleaning operation.

For this reason, a new Print Head Cleaning System was developed and loaded to the printing machine. The new system could keep the surface clean, and so we could obtain a stable ink ejection in continuous printing of wide size fabrics. Figure 5 shows a picture of the clean surface after the new cleaning process during continuous printing.

### New Print Head Cleaning System

Figure 6 shows the process flow of this new cleaning system. The print heads go through the cleaning process after each scan, and a cleaning blade made of high polymer sponge wipes the surface of the print head. The blade is then rinsed with pure water, the water soaked in the blade

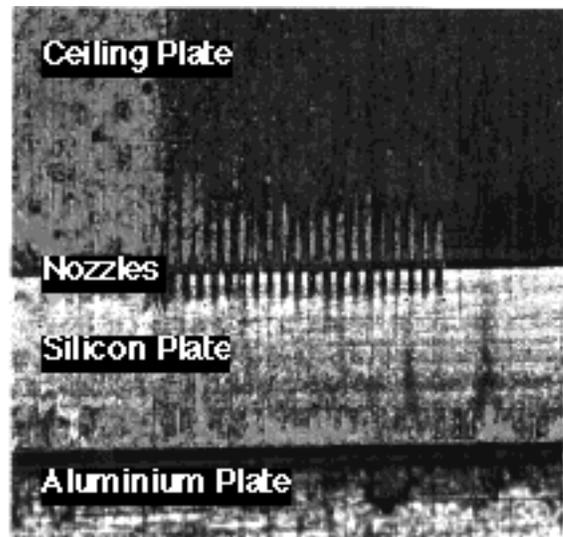


Figure 4. Our Head Cleaning System Used in a BJ Office Printer—ink adhesion on the surface of the print head

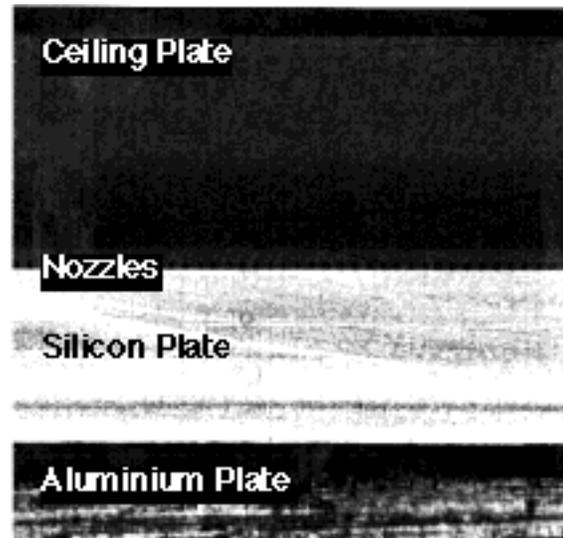


Figure 5. New Head Cleaning System—Clean surface of the print head

is vacuumed with a pump, and the cleaning system becomes ready for the next cleaning process.

### The Effectiveness of the New Print Head Cleaning System

1. Prevention of ink solidification on the surface of the print head

The surface of the print head is wiped with a blade made of porous material which contains a certain amount of water. Therefore the ink will not solidify on it even though high concentrated dye ink is used. So the surface will be kept always clean, and as a result, we can avoid ink clogging on the nozzles.

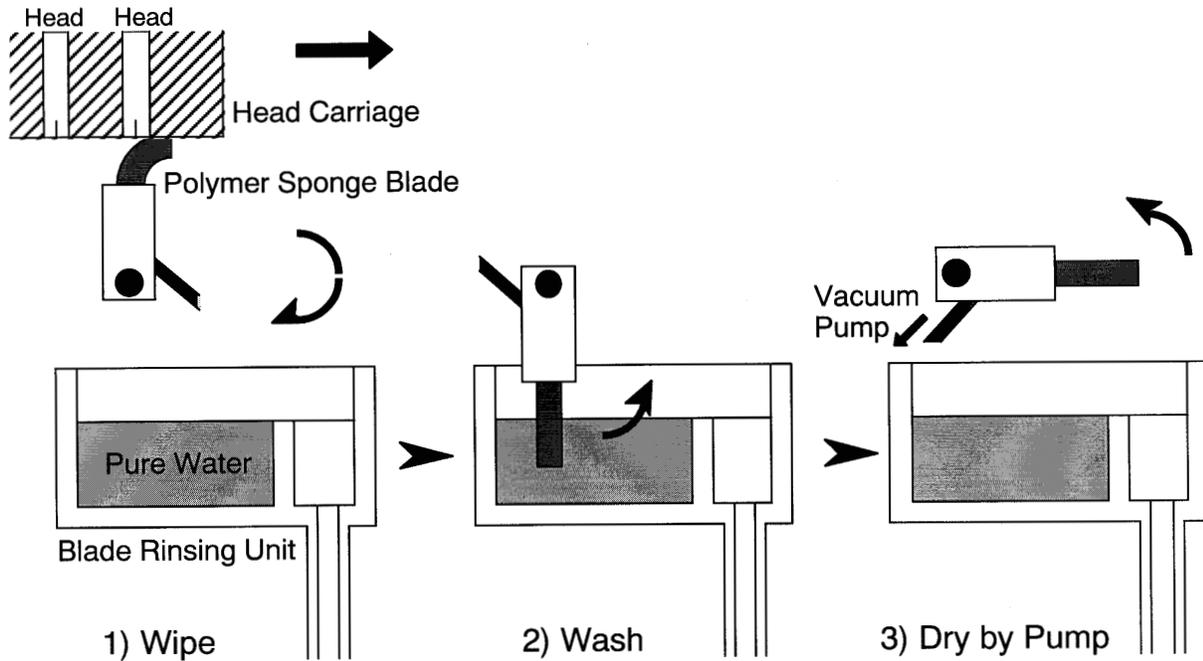


Figure 6. Process flow of the New Head Cleaning System

- Prevention of rinsing water (pure water) flowing backwards into the ink chamber

Normally, when the surface is wiped with rinsing water, the water will flow back through the nozzles, and further into the inside of the ink chamber of the print head. This will dilute the ink in it.<sup>2</sup>

On the other hand, the ink in the ink chamber will not be diluted by this cleaning system. The water in the porous blade will be vacuumed to a certain level with a pump. At this point, the surface of the print head will be wiped completely by the blade soaking up the ink from the nozzles.

- Keeping the blade always clean  
The blade is always clean because it is rinsed with pure water after each wiping process. Therefore, the blade can consistently wipe off ink mist and fluff from fabrics, and as a result, a complete recovery of the print head can be obtained.

## Conclusion

We have developed a textile printing system using BJ printing, in which we installed a new Print Head Cleaning System to keep the print head constantly clean. This resulted in high reliability on our BJ Textile Printing System.

Emission of waste water can be much decreased from the conventional system, so that it is friendly to the earth and also offers a clean working environment.

It is a full color screenless printing system, operating under Canon's original color image processing software. This shortens the total production process down to 2 weeks compared to 2 months required in conventional printing. Therefore, it can realize quick response and small lot production of real textile printing.

## References

- Y. Muira, BJ Textile Printing System, *17th Congress of IF-ATCC*, June 1996.
- U. S. Patent no. 4,970,535 (Tektronix Inc.).