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Overview of Piece Printing Process in Textile Industry

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Abstract: *Printing is a renowned process in textile industry which is generally done after dyeing. It is the last process to enhance aesthetic appeal of the fabric. Most of the buyer provide order of garments including printing process as various design can be imparted on the face side of garments indicating particular style and taste of the customer. Piece print has been able to draw the attention of customer by its variation of design. There are so many methods have been invented to apply the print paste onto the piece of garments.But the article related to piece print is not as much as available like all over print. This article deals with difference between all over print and piece print and various piece printing process on textile materials that frequently used.*

Keywords - *Curing, Cost of Piece print, Piece Printing Process, Sublimation Print, Techniques of Piece Print*

I. Introduction

The Printing is a discontinuous method of dyeing. Textile printing is related to dyeing but, whereas in dyeing proper the whole fabric is uniformly covered with one color, in printing one or more colors are applied to it in certain parts only, and in sharply defined patterns. In printing, wooden blocks, stencils, engraved plates, rollers, or silk-screens are used to place colors on the fabric. There are two types of printing process available in textile printing industry: all over print and piece print. In all over print, the fabric is printed before cutting and printing paste is applied simultaneously in the required place. Rotary screen printing machine and automatic flat bed screen printing machine are widely used for all over printing process. Here, fabric needs to be printed roll to roll and further drying and curing are followed respectively. After printing, the fabric rolls are delivered to cutting section before sewing operation starts. For all over print, sometimes it is difficult to identify the faults as the process runs continuously. So extra effort need to provide during the process.

In case of piece print, printing paste is applied after cutting, printing is done piece to piece of an individual component of garments. In piece printing it is easy to find faults and take necessary actions to recovery the problem. Several methods and techniques have been invented by the technologists to flourish the piece printing application. Printed pattern can perform excellent color fastness depending on the types of fabric structure and composition, appropriate selection of dyes and pigments as well as proper methods choose. The standard methods for textile application are flat bed screen, rotary screen and engraved copper roller [1]. In case of piece printing flat bed screen is widely used as it is convenient for running the piece print operation. For piece print, the manufacturer need to be more careful for selecting the individual component of garments as the required parts are sewn with other components after printing to make complete garments. In Bangladesh, according to buyer requirement, pigment print, rubber print, transfer or sublimation print, glitter print, puff print, flock print, foil print are widely used. So far many techniques have been identified

II. Techniques of Piece Printing

For printing color on a fabric, mostly three techniques are applied: Direct Printing, Discharge Printing and Resist Printing [14]. Direct printing, in which colorants containing dyes, thickeners, and the mordants or substances necessary for fixing the color on the cloth are printed in the desired pattern. Direct style of printing includes pigment print, rubber print, glitter print, puff print etc. Resist dyeing, in which a wax or other substance is printed onto fabric which is subsequently dyed. The waxed areas do not accept the dye, leaving uncolored patterns against a colored ground. Discharge printing, in which a bleaching agent is printed onto previously dyed fabrics to remove some other entire color. In transfer style, no flat screen machine is required as the design is transferred from paper to fabric by heat transfer printing machine

III. Machine Required for Piece Printing

3.1 Circular Screen Printing

In flat screen printing, a screen on which print paste has been applied is lowered onto a section of fabric. A squeezer then moves across the screen, forcing the print paste through the screen and into the fabric

Normally pigment printing, reactive printing and disperse printing are carried out by using the flat screen for piece print.

Fig.1: Circular Screen Printing Machine

3.2 Curing Machine:

To continue the process of all types of piece print, curing is mandatory. It is used for complete fixing of the printed paste onto the textile material. Here the temperature and belt speed is controllable.

Fig.2: Curing Machine

3.3 Heat Press Machine:

Heat press machine is required to fulfill the process of foil print. Temperature and pressure can be controlled during the application.

Fig.3: Heat Press Machine

3.4 Sublimation Print Machine

This type of machine is required for sublimation printing method whereas the design is transferred to fabric from paper. It may be single headed or double headed. The capacity of machine varies from manufacturer to manufacturer.

Fig.4: Sublimation Print Machine

IV. Common Flowchart for Piece Printing

V. Different Types of Piece Printing

5.1 Pigment Printing

Pigments are mainly synthetic organic materials. Pigment has no attraction to fiber so extra chemicals are required to facilitate its binding. Namely thickeners, binders, emulsifiers, fixing agents, silicone products, softeners and defoamers are required to make effective print paste [2] [3]. We know that pigment has no affinity to cotton fabric for this reason binder is required during printing. Pigment printing is done to produce attractive design by applying pigment paste on the fabric surface. Pigments are available in particle state and the particle size range should be in the region of 0.1 – 3 microns [4]. For piece printing, pigment paste is applied through flat screen printing machine. Pigment printing is suitable for both natural and man made fiber.

Flow chart of pigment printing process:

Paste preparation

↓

Table preparation/ Machine preparation

↓

Fabric plaited on the table

↓

Pigment printing paste apply with the help of screen

↓

Curing at 150 °C(for natural fiber)/180 °C(for man made fiber) (belt speed 5 m/min)

↓

Delivery

Fig.5: Pigment printed sample

5.2 Discharge Printing

Discharge means to remove specific colored area by another color or reducing it by bleaching agent. There are two types of discharge printing, one is white discharge and another is color discharge. In white discharge method, only dyed color of fabric is removed whereas in color discharge, after removing the dyeing color the required color is applied with discharging agent. Here, color is destroyed by one or multiple color. By this process pigment in the fabrics is removed chemically and replace it by another color. For discharge printing, fabric should be 100% cotton and the fabric should be dyed with dischargeable reactive dye [6].

Flow chart of pigment printing process [5] :

Paste preparation (White paste/ Color paste)

↓

Table preparation/ Machine preparation

↓

Fabric plaited on the table

↓

Pigment printing paste apply with the help of screen

↓

Curing at 190° C (belt speed 5 meter/minute)

↓

Delivery

Fig.6: Discharge printed sample

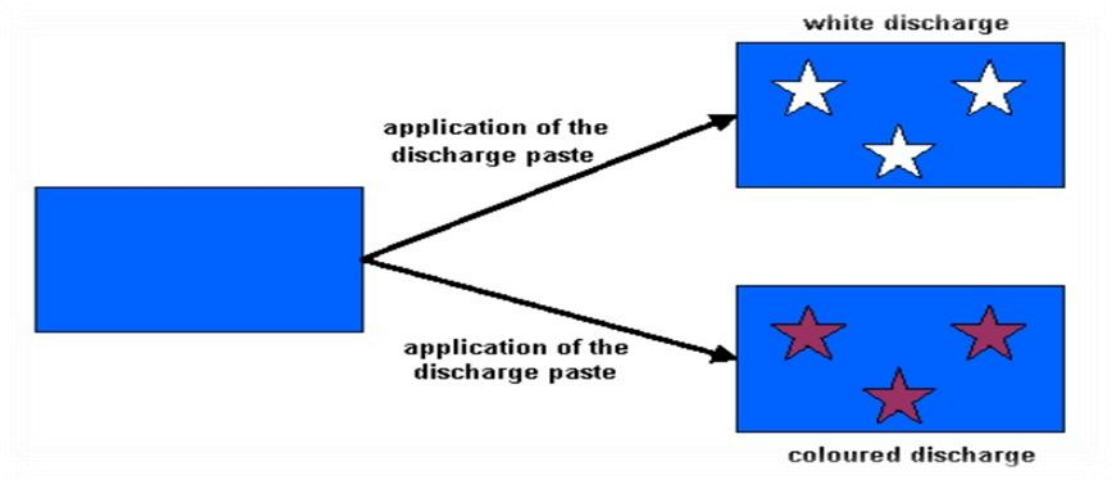


Fig.7: Appearance of white discharged and color discharged sample

5.3 Rubber Printing

A very common and versatile material that is used to print to garment due to its ability to adhere well to fabric. It can apply to most fabric materials in light or dark colours. The texture feels thick and tensile. A special rubber formulation has to be made in order to apply this print to elastic material

Flow chart of rubber printing process on cotton fabric [7] :

Table preparation
↓
Fabric plaited on the table
↓
Rubber printing paste apply with the help of screen
↓
Hanging the sample for 30 minutes
↓
Curing at 150°C (Belt speed 5 meter/minute)
↓
Delivery

Fig.8: Rubber printed sample

5.4 Plastisol Printing

Plastisol is commonly used as a textile ink for screen-printing and as a coating. Plastisol inks are recommended for printing on colored fabric and can retain a bright image. Plastisol comes in strengths from

transparent to very opaque and most printers will have the various versions available to use, depending upon the type and color of fabric they are printing on [8]. The various opacities of ink also vary greatly in price with the most opaque being the most expensive, mainly due to the cost of the increased pigment. Most Plastisols need about 150 degrees Celsius for full curing. Plastisol is the ink of choice for printing of finished goods such asT-shirts, sweatshirts and jackets. It gives plastic like hand feel on the applied surface.

Flow chart of plastisol printing process:

Printing paste preparation
↓
Table preparation
↓
Fabric plaited on the table
↓
High-density paste apply by screen
↓
Curing at 150°C (belt speed 3meter/minute)
↓
Delivery

Fig.9: Plastisol printed sample

5.5 Process Printing

Process color printing, is known at four-color process printing, is a method that reproduces finished full-color artwork and photographs. The three primary colors used are cyan (process blue), magenta (process red), and yellow. These inks are translucent and are used to simulate different colors. The "K" in CMYK is black. Black ink is used to create fine detail and strong shadows. These 4 transparent ink colors can be used in combination, with varying degrees of transparency, to create any color. Custom Ink primarily uses this method to print photographic images, and this process works best on light colored shirts, like white or natural, because the transparent CMYK inks tend to pick up the hue of the shirt underneath them [10]. CMYK is most appropriate for printing images that are: cartoony or fantastic graphic, washed out or distressed full color graphics, heavily processed or saturated images where memory colors have already been tweaked [9].

Flow chart of process printing process:

Paste preparation
↓
Table preparation
↓
Fabric plaited on the table
↓
Printing paste is applied through 4 different screens on the fabric
↓
Curing at 150°C (belt speed 5meter/minute)
↓
Delivery

Fig.10: process printed sample

5.6 Foil Printing

Foil printing is a sublimation transfer printing process. Foil printing is done by the help of paper. Foil paper is solid color which is made by buyer requirement. There are various kinds of foil paper available for use in foil stamping such as metallic foil paper, gloss pigment foil paper, matte pigment foil paper, and holographic foil paper [18] . Foil printing is a special kind of printing procedure where heat, pressure, and a metallic paper (foil) is used to create different shiny designs and graphics on various materials. By this printing process man-made and natural both fabric types can be printed.

Flow chart of foil printing process [11] :

Fabric plaited on the table
↓
Foil paste apply by screen
↓
Dry slightly in air temp / Hand dryer
↓
Apply foil paper on the fabric
↓
Heat apply by heat press m/c 150 °C for 5 second
↓
Cooling for 4 second
↓
Foil paper removed by hand
↓
Delivery

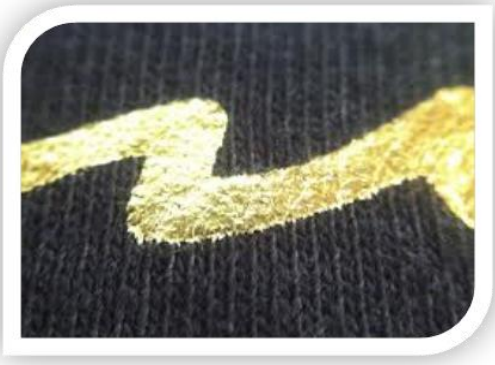


Fig.11: Foil printed sample

5.7 Flock Printing

Flock printing is done by depositing various flocks on the surface of the fabric. Flocks means small finely cut natural or synthetic fibers may be dyed or raw color and these flocks are applied on an adhesive coated surface for impart a decorative or functional characteristics to the required surface of the fabric [13]. Flock printing is always done on a piece of garments and hairy hand feel is realized.

Flowchart of flock printing process for cotton fabric [13]:

Fabric plaited on the table
↓
Apply flock paste with the help of screen
↓
Flock powder apply with the help of flock gun
↓
Manually dry by hanging for 30min
↓
Curing at 180°C (belt speed 3 meter / minute)
↓
Delivery
↓
Brushing
↓
Delivery

Fig.12: Flock printed sample

5.8 Glitter Printing:

Glitter is a transfer printing process and very useful for piece printing. After pre-treatment of the fabric, printing operation is done on the table. Rubber paste, fixer and glitter are required for making glitter printing paste though it varies from manufacturing company. Printing glitter paste is applied on the fabric by the screen printing process. After printing, curing is done at high temperature. Curing should be done slowly otherwise it may affect the printing performance.

Sequence of glitter printing process [14]:

Glitter paste preparation
↓
Table preparation
↓
Fabric plaited on the table
↓
Glitter paste apply by screen
↓
Hanging for 15min for dry
↓
Curing at 160°C (belt speed 3 meter/minute)
↓
Delivery

Fig.13: Glitter printed sample

5.9 Puff Printing:

Emboss printing is not as available as pigment printing, foil printing, flock printing or any others dyes printing. It is specially done for logo making or others decorative purpose. In this printing process, printing is done by embossing the printing paste on the textile materials. It is almost similar to the rubber printing process but the difference is here emboss or foaming paste is applied to appear the desired look [16].

Flow chart of puff printing process:

preparation with puff chemical
↓
Table preparation
↓
Fabric plaited on the table
↓
Apply printing paste by screen (3times)
↓
Hanging f or 15min
↓
Curing at 150 °C (belt speed 3meter/minute)
↓
Delivery

Fig. 14: Puff printed sample

5.10 Crack Printing

Crack printing is a printing method to produce attractive design on the fabric surf ace. Here rubber is used as the printing paste. It is near similar as rubber printing process but additional crack paste is used before applying rubber printing paste by the screen printer on the cotton fabric.

Process Sequence of crack printing process:

Preparation with cracking chemical
↓
Crack paste/clear apply with the help of screen
↓
Dry in air temp or hand dryer machine (slight)
↓
Printing paste apply with the help of screen
↓
Curing at 150°C (belt speed 2 m/min)
↓
Delivery

Fig.15: Crack printed sample

5.11 Sublimation Printing:

Sublimation is a transfer printing process. It is pigment based printing. Any type of design having greater complexity can easily be developed on the fabric surface .The sublimation transfer printing process consists of dye transfer in the vapour form from the paper to the fabric and this process is used on the commercial scale for transfer printing of 100% polyester fabric [17]. In sublimation printing machine, image is first engraved on a copper plate and then pigment is applied on this plate. The image is then transferred to a piece of paper . Here, the printed design is transferred from paper to fabric surface through heat pressing and then delivered after inspection.

Sequence of sublimation printing process:

Design creation and input in printing machine
↓
Color selection
↓
Printed paper output
↓
Check to match with approved standard
↓
Change dyes if required otherwise proceed
↓
Design transfer on fabric through heat press (Normally for 30 to 40 second in 200 ºC)
↓
Inspection
↓
Delivery

Figure 16: Sublimation Printed sample

Figure 17: Sublimation Paper print machine

VI. Characteristics of Different Types of Piece Print

Factors	Pigment Printing	Discharge printing	Rubber print	Plastisol print

Under Stretch	Crack	No crack	No crack	No crack
Hand feel	Harsh	Smooth	Rough	Smooth & soft
Base	Water base	Water base	Semi water	Oil base
Cost	Cheaper	Slight Costly	Costly	Costly
Application	All fabrics	Mainly on deep shade fabrics	All fabrics	All fabrics

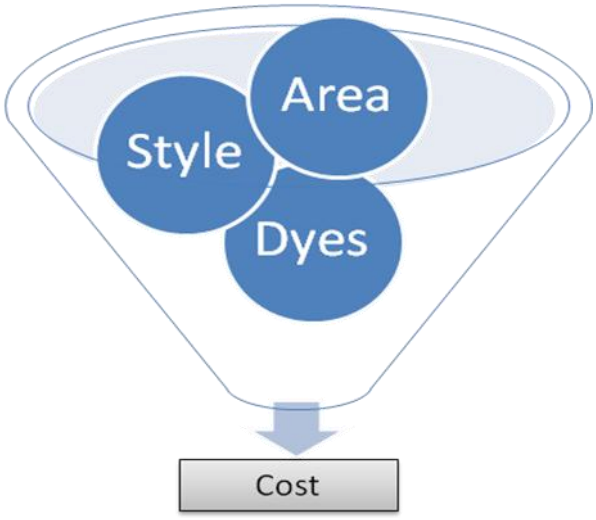
VII. Cost of Piece Print

Various factors can be considered for costing of garments print or piece print and all the factors can be brought into two main costing area such as chemical cost and manufacturing overhead.

Cost of Printing = Chemical Cost+ Manufacturing Overhead

Chemical Cost:

- Total no. of color
- Printed Area
- Types of Printing
- Total Amount of Printing
- Energy Cost
- Dyes and auxiliaries used in printing



Manufacturing Overhead:

- Wage of workers
- Machine Depreciation
- Floor Rent

VIII. Conclusions

A great innovation in design and sale appeal can be enhanced for piece print by following various printing method. The selection of printing process depends on different criteria such as the design, style, fabric composition, construction, types of dye used , buyer requirement and so on. Maximum buyer of garments try to

make unique their products by introducing something special and the types of printing process in piece print have successfully ensured their demand along with the quality. Further research should be carried out to make the piece printing process more flexible and economic as well as user friendly.

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