KRISHNENDU DAS

SEMESTER – IV

SKILL ENHANCEMENT COURSE

SERI – TEXTILE TECHNOLOGY (Unit -5)

PRINTING OF SILK FABRIC

Textile printing is the process of applying colour to fabric in definite patterns or designs. In properly printed fabrics the colour is bonded with the fibre, so as to resist washing and friction. Textile printing is related to dyeing but in dyeing properly the whole fabric is uniformly covered with one colour, whereas in printing one or more colours are applied to it in certain parts only, and in sharply defined patterns.
In printing, wooden blocks, stencils, engraved plates, rollers, or silkscreens can be used to place colours on the fabric. Colourants used in printing contain dyes thickened to prevent the colour from spreading by capillary attraction beyond the limits of a pattern or design

Methods

Traditional textile printing techniques may be broadly categorized into four styles:

- Direct printing, in which colourants containing dyes, thickeners, and the mordants or substances necessary for fixing the colour on the cloth are printed in the desired pattern.
- The printing of a mordant in the desired pattern prior to dyeing cloth; the colour adheres only where the mordant was printed.
- 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 uncoloured patterns against a coloured ground.
- Discharge printing, in which a bleaching agent is printed onto previously dyed fabrics to remove some or all of the colour.

Resist and discharge techniques were particularly fashionable in the 19th century, as were combination techniques in which indigo resist was used to create blue backgrounds prior to block-printing of other colours.[2] Modern industrial printing mainly uses direct printing techniques.

The printing process does involve several stages in order to prepare the fabric and printing paste, and to fix the impression permanently on the fabric:

- pre-treatment of fabric,
- preparation of colours,

- preparation of printing paste,
- impression of paste on fabric using printing methods,
- drying of fabric,
- fixing the printing with steam or hot air (for pigments),
- after process treatments.

Preparation of cloth for printing

Cloth is prepared by washing and bleaching. For a coloured ground it is then dyed. The cloth has always to be brushed, to free it from loose nap, flocks and dust that it picks up whilst stored. Frequently, too, it has to be sheared by being passed over rapidly revolving knives arranged spirally round an axle, which rapidly and effectually cuts off all filaments and knots, leaving the cloth perfectly smooth and clean and in a condition fit to receive impressions of the most delicate engraving. Some fabrics require very careful stretching and straightening on a stenter before they are wound around hollow wooden or iron centers into rolls of convenient size for mounting on the printing machines.

Preparation of colours

The art of making colours for textile printing demands both chemical knowledge and extensive technical experience, for their ingredients must not only be in proper proportion to each other, but also specially chosen and compounded for the particular style of work in hand. A colour must comply to conditions such as shade, quality and fastness; where more colours are associated in the same design each must be capable of withstanding the various operations necessary for the development and fixation of the others. All printing pastes whether containing colouring matter or not are known technically as colours.

Colours vary considerably in composition. Most of them contain all the elements necessary for direct production and fixation. Some, however, contain the colouring matter alone and require various after-treatments; and others again are simply thickened mordants. A mordant is a metallic salt or other substance that combines with the dye to form an insoluble colour, either directly by steaming, or indirectly by dyeing. All printing colours require thickening to enable them to be transferred from colour-box to cloth without running or spreading beyond the limits of the pattern.

Thickening agents

The printing thickeners used depend on the printing technique, the fabric and the particular dyestuff . Typical thickening agents are starch derivatives, flour, gum arabic, guar gum derivatives, tamarind, sodium alginate, sodium polyacrylate, gum Senegal and gum tragacanth, British gum or dextrine and albumen.

Hot-water-soluble thickening agents such as native starch are made into pastes by boiling in double or jacketed pans. Most thickening agents used today are cold-soluble and require only extensive stirring.

Starch paste

Starch paste is made from wheat starch, cold water, and olive oil, then thickened by

boiling. Non-modified starch is applicable to all but strongly alkaline or strongly acid colours. With the former it thickens up to a stiff unworkable jelly. In the case of the latter, while mineral acids or acid salts convert it into dextrine, thus diminishing its viscosity or thickening power, organic acids do not have that effect. Today, modified carboxymethylated cold soluble starches are mainly used. These have a stable viscosity and are easy to rinse out of the fabric and give reproducible "short" paste rheology.
Flour paste is made in a similar way to starch paste; it is sometimes used to thicken aluminum and iron mordants. Starch paste resists of rice flour have been used for several centuries in Japan.

Gums

Gum arabic and gum Senegal are both traditional thickenings, but expense prevents them from being used for any but pale, delicate tints. They are especially useful thickenings for the light ground colours of soft muslins and sateens on account of the property they possess of dissolving completely out of the fibres of the cloth in the post-printing washing process, and they have a long flowing, viscous rheology, giving sharp print and good penetration in the cloth. Today guar gum and tamarind derivates offer a cheaper alternative.
British gum or dextrin is prepared by heating starch. It varies considerably in composition, sometimes being only slightly roasted and consequently only partly converted into dextrine, and at other times being highly torrefied, and almost completely soluble in cold water and very dark in colour. Its thickening power decreases and its gummy nature increases as the temperature at which it is roasted is raised. It is useful for strongly acid colours, and with the exception of gum Senegal, it is the best choice for strongly alkaline colours and discharges. Like the natural gums, it does not penetrate as well into the fibre of the cloth pr as deeply as pure starch or flour and is unsuitable for very dark, strong colours.
Gum tragacanth, or Dragon, which may be mixed in any proportion with starch or flour, is equally useful for pigment colours and mordant colours. When added to a starch paste it increases its penetrative power and adds to its softness without diminishing its thickness, making it easier to wash out of the fabric. It produces much more even colours than does starch paste alone. Used by itself it is suitable for printing all kinds of dark grounds on goods that are required to retain their soft clothy feel.
Starch always leaves the printed cloth somewhat harsh in feeling (unless modified carboxymethylated starches are used), but very dark colours can be obtained. Gum Senegal, gum arabic or modified guar gum thickening yield clearer and more even tints than does starch, suitable for lighter colours but less suited for very dark colours. (The gums apparently prevent the colours from combining fully with the fibers.) A printing stock solution is mostly a combination of modified starch and gum stock solutions.

Albumen

Albumen is both a thickening and a fixing agent for insoluble pigments. Chrome yellow, the ochres, vermilion and ultramarine are such pigments. Albumen is always dissolved in the cold, a process that takes several days when large quantities are required. Egg albumen is expensive and only used for the lightest shades. Blood albumen solution is used in cases when very dark colours are required to be absolutely fast to washing. After printing, albumen thickened colours are exposed to hot steam, which coagulates

the albumen and effectually fixes the colours.

Printing paste preparation

Combinations of cold water-soluble carboxymethylated starch, guar gum and tamarind derivatives are most commonly used today in disperse screen printing on polyester. Alginates are used for cotton printing with reactive dyes, sodium polyacrylates for pigment printing, and in the case of vat dyes on cotton only carboxymethylated starch is used.
Formerly, colours were always prepared for printing by boiling the thickening agent, the colouring matter and solvents, together, then cooling and adding various fixing agents. At the present time, however, concentrated solutions of the colouring matters and other adjuncts are often simply added to the cold thickenings, of which large quantities are kept in stock.
Colours are reduced in shade by simply adding more stock (printing) paste. For example, a dark blue containing 4 oz. of methylene blue per gallon may readily be made into a pale shade by adding to it thirty times its bulk of starch paste or gum, as the case may be. The procedure is similar for other colours.
Before printing it is essential to strain or sieve all colours in order to free them from lumps, fine sand, and other impurities, which would inevitably damage the highly polished surface of the engraved rollers and result in bad printing. Every scratch on the surface of a roller prints a fine line on the cloth, and too much care, therefore, cannot be taken to remove, as far as possible, all grit and other hard particles from every colour.
Straining is usually done by squeezing the colour through filter cloths like artisanal fine cotton, silk or industrial woven nylon. Fine sieves can also be employed for colours that are used hot or are very strongly alkaline or acid.

Methods of printing

There are eight distinct methods presently used to impress coloured patterns on cloth:

- Hand block printing
- Perrotine printing
- Engraved copperplate printing
- Roller, cylinder, or machine printing
- Stencil printing
- Screen printing
- Digital textile printing
- Flexo textile printing
- Discharge Printing

Block printing

This process is the earliest, simplest and slowest of all printing methods. A design is

drawn on, or transferred to, prepared wooden blocks. A separate block is required for each distinct colour in the design. A blockcutter carves out the wood around the heavier masses first, leaving the finer and more delicate work until the last so as to avoid any risk of injuring it when the coarser parts are cut. When finished, the block has the appearance of a flat relief carving, with the design standing out. Fine details, difficult to cut in wood, are built up in strips of brass or copper, which is bent to shape and driven edgewise into the flat surface of the block. This method is known as coppering.
The printer applies colour to the block and presses it firmly and steadily on the cloth, striking it smartly on the back with a wooden mallet. The second impression is made in the same way, the printer taking care to see that it registers exactly with the first. Pins at each corner of the block join up exactly, so that the pattern can continue without a break. Each succeeding impression is made in precisely the same manner until the length of cloth is fully printed. The cloth is then wound over drying rollers. If the pattern contains several colours the cloth is first printed throughout with one colour, dried, and then printed with the next.
Block printing by hand is a slow process. It is, however, capable of yielding highly artistic results, some of which are unobtainable by any other method. William Morris used this technique in some of his fabrics.

Screen Printing

Screen printing is a printing technique where a mesh is used to transfer ink onto a substrate, except in areas made impermeable to the ink by a blocking stencil. A blade or squeegee is moved across the screen to fill the open mesh apertures with ink, and a reverse stroke then causes the screen to touch the substrate momentarily along a line of contact. This causes the ink to wet the substrate and be pulled out of the mesh apertures as the screen springs back after the blade has passed. One color is printed at a time, so several screens can be used to produce a multicoloured image or design.
There are various terms used for what is essentially the same technique. Traditionally the process was called screen printing or silkscreen printing because silk was used in the process. It is also known as **serigraphy**, and **serigraph printing**. Currently, synthetic threads are commonly used in the screen printing process. The most popular mesh in general use is made of polyester. There are special-use mesh materials of nylon and stainless steel available to the screen printer. There are also different types of mesh size which will determine the outcome and look of the finished design on the material.

Screen printing press

To print multiple copies of the screen design on garments in an efficient manner, amateur and professional printers usually use a screen printing press. Many companies offer simple to sophisticated printing presses. These presses come in one of three types, Manual (also referred to as Handbench), Semi-Automatic, and Fully Automatic. Most printing companies will use one or more semi-automatic or fully automatic machines.

Rotary screen printing

A development of screen printing with flat screens from 1963 was to wrap the screen around to form a tube, with the ink supply and squeegee inside the tube. The resulting roller rotates at the same speed as the web in a roll-to-roll machine. The benefits are high output rates and long rolls of product. This is the only way to make high-build fully patterned printing/coating as a continuous process, and has been widely used for manufacturing textured wallpapers.