

Textile Printing: Need to use of environment friendly methods

by Dr. Noor Ahmed Memon.

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 fiber, so as to resist washing and friction. Textile printing is related to dyeing but, proper dyeing entails that 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.

There are different ways of classifying the finishes applied on fabrics. One of them is the extent to which they will stay on the fabrics, such as temporary, durable, and permanent finish. In printing, wooden blocks, stencils, engraved plates, rollers, or silk screens are used to place colours on the fabric. Colorants used in printing contain dyes thickened to prevent the colour from spreading by capillary attraction beyond the limits of the pattern or design. Traditional textile printing techniques may be broadly categorized into four styles:

1. Direct printing, in which colorants containing dyes, thickeners, and the mordant or substances necessary for fixing the colour on the cloth are printed in the desired pattern.
2. The printing of a mordant in the desired pattern prior to dyeing cloth; the colour adheres only where the mordant was printed.
3. 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.
4. Discharge printing, in which a bleaching agent is printed into previously dyed fabrics to remove some or the entire colour.

All the textile dyeing operations are being performed with special dyeing equipment are controlled by professional operators, which give great results. Since the time when the very first fabric weavers appeared, people tried to decorate their clothes, so the history of textile dyeing is as long as the craft of fabrics weaving itself.

During this long history different techniques and methods of textile dyeing have been developed. Painting on fabrics with different natural materials has been done for several thousand years. The actual industry of textile dyeing was born somewhere in the 16th century when an indigo was introduced in Portugal.

Since then a lot of new dyestuffs have been developed and at the end of the 19th century with the breakthrough in chem-

istry many new interesting discoveries were made. At that time, the first synthetic fiber was discovered and the very first organic dye came to life. Soon after that different sorts of mordant agents were introduced. Such a combination of totally new material for fabrics weaving and colouring was a huge step in a textile history.

The textile dyeing industry improved greatly due to these developments, and such discoveries ensured the emergence of much cheaper and faster textile dyeing processes and finishing applications. Nowadays, more beautiful and colourful clothes are being produced and use of new dyestuffs offer much easier application possibilities, than the use of natural dyestuffs.

Textile industries use different chemicals in different processes; dyeing, finishing, scouring, bleaching, softening, washing, etc. The textile chemicals and dyeing industry consume large quantities of water and produces large volumes of waste water from different steps in the various processes.

Wastewater from textile processing and dyeing containing residues requires appropriate treatment before being released into the environment. Interest in eco-friendly processing in textile industry has increased in the current scenario because of increased awareness of environmental issues. Enormous amounts of water and energy are consumed in the production and care of textiles.

The processing sector contributes mostly in terms of pollution as no adequate disposal of industrial chemical waste is in force. The processing industry has a vital task ahead for establishment of treatment plants and they need to devise programs to reduce chemical consumption via recycling and use of more concentrated dyes and/or effective chemical formulations will limit volume.

At present, the far most important factor is consideration is the carcinogenic effects of the chemicals, which are used for manufacturing dyes and intermediates. These hazardous compounds are directly or indirectly related with incidence of serious diseases like cancer, tumors of the urinary bladder and certain skin diseases.

For example, Azo dyes are toxic only after reduction and cleavage of the linkage to give aromatic amines. Azo dyes with structures containing free aromatic amines can be metabolically oxidized without Azo reduction.

Print Technology

Fabric processing is the most critical stage of value addition in the entire value chain. Woven or knit fabrics can either be dyed or printed depending upon the requirement of the customer, who is the garment or made-ups manufacturer. The use of coloured cotton being unique and attractive has the potential to become a part of cotton fabric and apparel market.

In recent years the usage of natural dyes and colours for fabric dyeing has witnessed its revival due to hazardous effects of synthetic dyes and chemicals. The natural dyes are eco-friendly, harmless and non-toxic in nature. Also, the usage of renewable sources of energy in textile and apparel industry has been increased due to many advantages associated with it.

Solar energy usage for dyeing purpose is a cost effective method. In hot countries like Pakistan, the sun shines bright for 60% of the day, for example, using solar energy to dye silk fabrics with turmeric dye is cheap and environment friendly method.

Digital Printing: The rapidly evolving world of digitalized textiles is a reflection of several unique and contrasting business models that create challenges, threats and opportunities to the future of the textile printing market. As the current trend is for the establishment of air-jet looms units, open-width processing units, and in printing major strength is of 'rotary' screen printing machines, further investments are being made for the import of latest machinery for bleaching, dyeing, printing and finishing.

Among the various approaches for digital printing including electro photography, inkjet has gained a very significant place in the field of innovative printing techniques. These technique are more related to those used in reprographics industry than textile printing industry. Inkjet printing offers low water and low energy consumption, compared with conventional printing process.

Digital printing techniques make new demands on the colorants and formulations used. While in screen printing colours are applied in the form of high viscosity pastes. In inkjet printing the requirement is for very thin ink formulations, moreover the colours or dyes to be used for inkjet printing should have small particle size, as over sized particles block the jets.

One of the important issues associated with digital printing on textiles is speed and reliability as this has commercial implication for the industry, in terms of time and energy saving factors.

Inkjet printing has also some demerits such as high cost, lower production speed, limited colour space, and so on. Therefore, there is a need to improve the system efficiency with more research and developments.

Special functional finishes: A wide range textile products are now available for specific processing techniques. Initially, the primary objective of the finish is to protect textiles from being affected by microbes particularly fungi.

Uniforms, tents, defence textiles and technical textiles, such as, geo-textiles have therefore all been finished using antimicrobial agents. Later, the home textiles, such as, curtains coverings, and bath mats came with antimicrobial finish.

The application of the special finishing of textile products is now extended to textiles used for outdoor, healthcare sector, sports and leatures industry. Today new chemical treatments for bleaching, dyeing and mercerizing provided better strength, less shrinkage, bright colours and whiter cottons. At higher production rate and longer production hours, mills could produce more finished fabric than ever before

and with greater consumer appeal.

Plasma technology: The changing technology trends, evolving from hand power, to water power to steam and then to electricity, fundamentally changed the textile industry, its product marketability and its profitability. Now its time for yet another change! Plasma technology is poised to change the concept of textile wet processing.

Plasma modification of textiles saves large quantity of water, chemicals and electrical energy, which is made possible since the plasma process does not produce large volume of waste or toxic by-products. Over the past decade there has been rapid exploration and commercialization of plasma technology to improve the surface properties of textile material without changing the bulk properties.

Antimicrobial finishing: The antimicrobial agents can be applied to the textile substrates by exhaust, pad-dry-cure, coating, spray and foam techniques. The substance can also be applied by directly, while spinning or can be applied online during the dyeing and finishing operations. Various methods for improving the durability of the finish include:

- ❖ Treating the fibre with resin, condensates or cross-linking agents.
- ❖ Micro encapsulation of the antimicrobial agents with the fibre matrix.
- ❖ Coating the fibre surface.
- ❖ Chemical modification of the fibre by covalent bond formation.
- ❖ Use of graft polymers, homo polymers and/or co-polymerization on to the fibre.

Pakistan textile printing industry

Textiles and clothing trade is a vital part of the world economy with many nations heavily dependent on the sector for foreign exchange earnings and employment generation.

Research, innovations and development in technical textiles, yarn quality, clothing products, process performance, fabric finishing, coloration technology and marketing can bring significant advancement in textile sector and market supremacy. Pakistan textile printing and processing units have been classified into three categories per here below:

1. Integrated units, which possess complete finishing facilities i.e. bleaching mercerizing, dyeing, calendaring and printing. They procure cloth and market thereafter under their own brand names. They also occasionally out source finishing facilities to other traders.
2. Individual units in this grouping directly compete with the products of integrated units. In terms of quality, design and colour, their products are not inferior from products of integrated mills. Similar to the integrated mills these units also sell their products in wholesale market.
3. Such units, which do not have complete finishing facilities, fall in this assemblage. They are engaged in bleaching and dyeing and perform more work on job order basis. They also procure cloth from the market place and sell thereafter under their own brand names.

**Table - 1
Production of Cloth**

(Million sq. meters)

Year	Cotton Cloth	Blended Cloth	Total
2003-04	582	102	684
2004-05	842	83	925
2005-06	863	52	915
2006-07	917	61	978
2007-08	951	65	1,016
2008-09 (Provisional)	985	69	1,054

Source: Textile Commissioner's Organization, Government of Pakistan.

Table - 2
Export of Cotton Fabrics

Year	Quantity (Million sq. meters)	Value (US\$ Million)	Average (\$ sq. meter)
1999-00	1,575	1,096	0.71
2000-01	1,736	1,035	0.60
2001-02	1,957	1,133	0.58
2002-03	2,036	1,346	0.66
2003-04	2,409	1,711	0.71
2004-05	2,399	1,863	0.78
2005-06	2,634	2,108	0.80
2006-07	2,211	2,026	0.90
2007-08	2,035	2,010	0.99
2008-09	1,882	1,929	1.02

Source: Export Promotion Bureau, Government of Pakistan.

At present about 650 independent processing units are working in and around Faisalabad, Gujranwala and Karachi, in which about 50 integrated units have complete finishing facilities. Most of the available units working on Hi-Tec machines are owned by big industrial and commercial cartels.

Over the last seven years textile sector has invested more than \$ 7.0 billion in modernization and higher value addition. As the current trend is for the establishment of air-jet looms units, open-width processing units, and in printing major strength is of 'rotary' screen printing machines, further investment made for the import of latest machinery for bleaching, dyeing, printing and finishing.

Production of cloth: Cloth is being produced in both mill and non-mill sectors. Pakistan fabric's range from course to super varieties, with coarse and medium varieties consumed locally. The use of coloured cotton being unique and attractive has the potential to become a part of cotton fabric and apparel market but there are some limitations to it.

The natural coloured cotton is low in yield usually short staple and weaker in strength. Such a fibre has high maturity as compared to white cotton. There are a large number of vertically integrated units, where production is controlled from fibre to the end product, and marketed abroad directly.

Production of cloth (mill sector) increased from 684 million sq. meters in

2003-04 to 1,054 million sq. meters in 2008-09, thus showing an average 9% per annum. Out of total production of 683 million sq. meters cloth during 2005-06 in mill sector, 49% produced in grey form, 30% dyed and printed, 15% blended and 6% bleached. Production of cloth (mill-sector) is given in Table-1.

Exports: The global trade in woven fabric can be classified into two broad categories, cotton and blended fabrics and synthetic and artificial fabrics, commonly referred to as man-made fabrics. Asia is fast emerging as major source of exports, especially of textiles, to the USA, EC and other countries of the world. Pakistan has emerged as one of the major cotton textile product suppliers in the world market. Pakistan's textile products have become less competitive in the international market owing to tough competition from Bangladesh, India and China.

Pakistan export of textile manufactures were US \$ 9.6 billion during 2008-09, which is 54% of the total exports. Export of cotton fabrics decreased from 2.63 billion sq meters worth US \$2.11 billion in 2005-06 to 1.88 billion sq meters worth US \$ 1.93 billion in 2008-09, thus showing decline of 8.5% per annum in terms of value.

The major markets for Pakistan's fabrics are USA, Turkey, Hong Kong, Italy, UK, Bangladesh, Spain and Dubai. Export of cotton fabrics from Pakistan is given in Table-2.

Conclusion

Dyeing, finishing and printing of textiles constitutes innumerable steps leading to finished product, each having a number of complex variables. With the increasing consumer awareness, the developments are taking place at a rapid pace to satisfy the customer with quality product and competitive price.

Though underlying principle for developments is satisfying customer needs, much emphasis is being paid for conserving water and energy and simultaneously being environment friendly and this in turn will impart cost competitiveness.

There is an urgent need to focus on minimizing water pollution and air pollution and possibly through on use of biodegradable chemicals preferably from renewable sources.

References

1. Anita A. Desai " Plasma technology: A review". The India Textile Journal, January 2008.
2. Aravin Prince and Pand Raja P. "Digital Printing" The India Textile Journal, August 2007.
3. Dr. M.S. Parmar, M. Singh and Nehra "Wet processing of garment: Some facts". North India Textile Research Association.
4. [Http://www.answers.com./topic/textile-printing](http://www.answers.com./topic/textile-printing). ♦