

Textile Screen Printing Process: A Comprehensive Overview

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Abstract

Textile screen printing is a versatile and widely used method for applying designs onto fabric. This process involves the use of a stencil (or screen) to transfer ink onto the textile substrate. This article provides a detailed overview of the textile screen printing process, covering its history, techniques, materials, and advancements. Additionally, the article explores the advantages and limitations of screen printing compared to other printing methods.

Introduction

Screen printing, also known as silk screening, is one of the oldest and most popular printing techniques used in the textile industry. Known for its versatility, durability, and vibrant color reproduction, this method has been utilized in various industries, from fashion and home textiles to promotional items and industrial fabrics. The process has evolved significantly with technological advancements, making it more efficient and versatile.

History of Screen Printing

The origins of screen printing can be traced back to ancient China during the Song Dynasty (960–1279 AD), where it was used to print patterns on fabric. The technique spread to other Asian countries and later to Europe in the 18th century. The commercial use of screen printing began in the early 20th century, driven by industrialization and advancements in printing technology, particularly in the advertising and garment industries. The introduction of synthetic materials and automated equipment has since transformed the process, making it more efficient and accessible.

The Screen-Printing Process

Materials and Equipment

Screens: Made of polyester or nylon mesh with varying mesh counts depending on the detail and thickness of the ink required is stretched over aluminium or wooden frames.

Inks: Pigment, Plastisol, water-based, discharge, and specialty inks like puff, metallic, and glitter.
Printing Table- Manual, semi-automatic, fully automatic.

Squeegees: Typically made of rubber, used to push the ink through the screen mesh.

Presses: Manual, semi-automatic, and automatic screen-printing presses.

Dryers: Air dryer/ press dryer/ Conveyor dryers for curing inks.

The screen-printing process involves several steps, each crucial for achieving high-quality prints. Below is a detailed breakdown of these steps:

1. Design Preparation

The first step in screen printing is to create or prepare the design. It can be created by hand or digital method. This is typically done using graphic design software. Each colour used in design is separated in different layer. Each layer is printed onto a transparent acetate sheet to create a positive image. It is printed in dark black so achieve light blocking effect.

2. Screen Preparation

The screen, made of a fine mesh stretched over a frame, is coated with a light-sensitive emulsion. Once the emulsion is dry, the acetate sheet with the design is placed on the screen, and the screen is exposed to ultraviolet (UV) light. The UV light hardens the emulsion except where the design blocks the light. The unhardened emulsion is then washed away, leaving a stencil of the design on the screen.



Metal frame screen for manual flatbed screen printing

Mesh Count for Different Prints:

Type of Print	Mesh count
Glitter	25–60
Flock adhesive	45–125
Puff-up colors	55–125
Overprint	80 –110
Pigment ink printing areas/lines	110 –175
Plastisol	125–305
Pigment inks, half-tone	155–255

Here is a basic recipe and process for preparing and applying the coating of photo-emulsion and sensitizer.

Materials Needed-

Photo-emulsion (pre-mixed photo-emulsions are available in market)

Sensitizer (if not pre-mixed)

Scoop coater.

Clean, dry screen

Mixing stick (if mixing is required)

Light-safe environment (a dim or yellow-light room to prevent premature exposure)

Coating Process

Preparation:

Emulsion requires mixing with a sensitizer, in case it is not premixed. It should be done in a light-safe environment according to the manufacturer's instructions. Typically, this involves pouring the sensitizer into the emulsion and stirring it thoroughly until fully blended.

Applying the Emulsion:

The clean and dry screen need to be placed in an upright position followed by application of emulsion mixture with the help of scoop coater. Scoop coaters need to be held at a 45-degree angle to the screen. Coating movement should always start from the bottom of the screen. A thin, even layer of emulsion is pulled up by the scoop coater in a smooth, continuous motion. The process can be for a more even coat if necessary. The coating room should be as dust-free as possible to avoid particles embedding in the emulsion. Screen need to be handled by the edges to avoid fingerprints or oil spots that can affect the coating.

Drying:

The screen is kept drying in a horizontal position with the print side down in a dark, dust-free environment. It should not come in contact of direct heat or light else it will become brittle.

Drying Time

Air Drying: 1 to 3 hours depending on humidity and temperature.

With Fan Assistance: 30 to 60 minutes.

In a Drying Cabinet: 20 to 30 minutes at a temperature not exceeding 40°C (104°F).

3. Setting Up the Printing Table

The screen-printing table can be manual, semi-automatic, or automatic tables. each offering different levels of efficiency and control. The fabric to be printed is placed on a table, which holds it in place during printing.

Traditional printing table have wax coating to provide soft and even printing surface. It acts as a temporary fixer for fabric placed on the it for printing. The semi-automatic tables have vacuum tables to keep fabric in place.

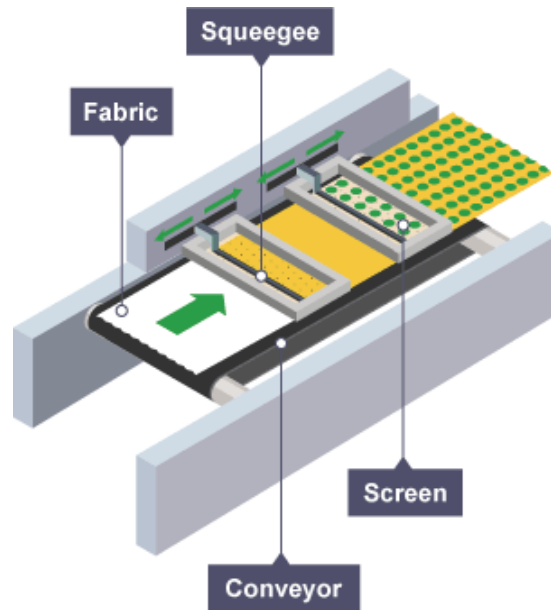
Fully automated tables have conveyer belts with vacuum for the same purpose.

4. Ink Preparation

Inks used in screen printing are specially formulated for different fabric types. Pigment dyes with water or oil-based binders are popularly used for all organic fabrics. Plastisol ink is used for knitted textiles due to its durability and vibrancy. Water-based and discharge inks are also preferred for their softer feel and eco-friendliness. Rapid dyes are also used for pastel shades and soft feel. The ink is prepared and mixed to achieve the desired colour and consistency.

5. Printing Process

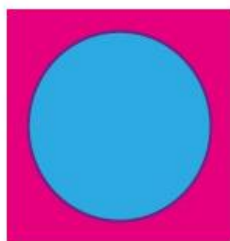
With the screen and fabric in place, ink is applied to the screen. A squeegee is used to press the ink through the mesh openings of the stencil and onto the fabric. This step may be repeated several times for multiple colours, with each colour requiring a separate screen and drying process between applications. The stoppers attached on table and handles on screen helps to guide the repeat printing.



Manual flatbed screen printing

Automatic Flat bed Screen printing

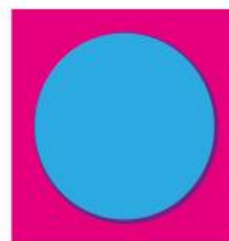
When designing stencils for silk-screen printing, it is crucial to consider how the borders of different colours will interact. The most common issue arises when adjacent colours in a design, particularly large flat areas, don't align perfectly. Gaps result in visible white spaces between the design elements, while overlaps create undesirable merging of colours along the edges. The effective solution to these issues is to print all colours with a slight, intentional overlap known as "trapping or imposition."



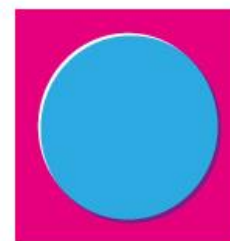
Drawing with imposition



Drawing without imposition



Printing result out of register



Printing result out of register



This technique ensures that any minor misalignments do not result in noticeable gaps or excessive overlaps. Therefore, incorporating these overlaps, or "traps," into the stencil design is essential for achieving a clean and visually appealing multi-coloured print.

6. Curing

After printing, the ink must be cured to ensure it adheres properly to the fabric. This can be done using a conveyor dryer, which heats the fabric to a specific temperature for a set period or air dryer or heat press. Proper curing ensures the print's durability and wash fastness. Rapid printing will require curing with acid and further washing with caustic soda.

Screen printed Ladies Shirt.
Image Curtsey-Alankarandesigns

Advantages of Screen Printing

Vibrant Colors: Screen printing produces bright and opaque colors, ideal for both light and dark fabrics. **Durability:** Prints are highly durable and can withstand repeated washing. **Versatility:** Can be used on various fabrics and other materials like plastics and glass. **Cost-Effectiveness:** Economical for large production runs due to the efficiency of the process.

Limitations of Screen Printing

Set-Up Time: The process requires significant setup time for preparing screens and designs. **Not Suitable for Small Runs:** Less cost-effective for small orders due to setup costs. **Complex Designs:** Intricate designs with many colours or gradient colours can be time-consuming and challenging to align correctly.

Advancements in Screen Printing

Technological advancements have improved the efficiency and capabilities of screen printing. Screen printing can be combined with digital techniques to enhance details and reduce setup times. Automated presses, better-quality screens, and eco-friendly inks have made the process faster, more reliable, and environmentally friendly.

Applications

Fashion and Apparel: T-shirts, hoodies, and other garments. Home Textiles: Bedding, curtains, and upholstery fabrics. Promotional Items: Bags, caps, and other branded merchandise. Industrial Uses: Flags, banners, and technical textiles.

Conclusion

Textile screen printing remains a dominant method in the textile industry due to its ability to produce vibrant, durable prints on a variety of fabrics. While it has its limitations, ongoing advancements continue to enhance its efficiency and reduce its environmental impact. Understanding the intricacies of the screen-printing process is essential for leveraging its full potential in textile production.

References

1. Lengwiler, G. (2013, January 1). *A History of Screen Printing*. [http://books.google.ie/books?id=huLVnQEACAAJ&dq=1.%09A+History+of+Screen+Printing.+\(2023\)&hl=&cd=1&source=gbs_api](http://books.google.ie/books?id=huLVnQEACAAJ&dq=1.%09A+History+of+Screen+Printing.+(2023)&hl=&cd=1&source=gbs_api), ref. on 22.05.2024
2. Techniques and Materials in Modern Screen Printing. (2022). *Textile World Journal*.
3. Environmental Impact of Textile Printing. (2021). *Green Print Journal*.
4. Sampson, J. (2017, May 26). *Screenprinting*. The Crowood Press.
5. Islam, H. (2021, March 21). *What is Screen Printing on garments? Screen printing process step by step*. Textile Research and Development. <https://textilernd.com/what-is-screen-printing-on-garments-screen-printing-process-step-by-step/>
6. *Commercial processes - Textile-based materials - AQA - GCSE Design and Technology Revision - AQA - BBC Bitesize*. (2024, May 14). BBC Bitesize. <https://www.bbc.co.uk/bitesize/guides/zjc3rwx/revision/9>
7. *Demografieberatung Digi+ - Chancen ergreifen. Zukunft gestalten*. (2023, December 14). Demografieberatung Digi+. <https://demografieberatung.at>
8. www.alankarandesigns.com