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ICT-TEX

Training module: FINISHING, PRINTNIG and FUNCTIONALIZATION

Course: Basic Principles of Textile Printing

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Cooperation for innovation and the exchange of good practices Knowledge Alliance

ICT IN TEXTILE AND CLOTHING HIGHER EDUCATION AND BUSINESS

Project Nr. 612248-EPP-1-2019-1-BG-EPPKA2-KA

- ✓ Screen production with technical characteristics
- ✓ Mechanisms of hydrodynamic pressure in the paste wedge and printing paste flow

- ✓ Flat screen production
- ✓ Screen meshes
- ✓ Rotary screens construction
- ✓ The amount of paste printed onto material, flow and print mechanism

❑ FLAT SCREEN PREPARATION

- In screen printing many parameters from the aspect of the screens must be controlled, in order to ensure accurate printing results. From cloth, mesh, net frame to the screen tension and other parameters, these must be based on the needs of printed matter to determine.
- **Frames** for flat screens are nowadays usually made of steel, with hollow cross-section to obtain lighter weight or of aluminum. The advantage of an metal screen printing frame is the durability and longevity it retains. Unlike wood silk screen printing frames, when exposing to water metal frames will not warp. Aluminum frames, for example, can be stretched and re-stretched many times (meaning that the mesh can be repeatedly attached to a frame, making a new screens using the same frame. The mesh and glue are simply removed from the frame using a professional tool that doesn't damage the aluminum. Once cleaned, the frames can then be re-stretched.
- As for the **mesh material** there are currently two kinds of used in screen printing: polyamide PA (nylon) screen printing mesh and polyester (PES) screen printing mesh. Although polyester materials have been widely used, screen printing companies are generally willing to use screen printing mesh made of nylon.

- Polyester screen printing mesh has many unique advantages, such as solution, high temperature, water and chemicals resistance. In addition, his physical properties remain stable and scalability low when severe external pressure is applied. However, compared with nylon, polyester wear resistance is almost the same.
- Because of its dimensional stability, polyester screen printing mesh is ideal for printings that require high accuracy. The shortcomings of nylon screen printing mesh is stretching, tension retention ability is poor. After using for a period of time, the tension of the screen will be weakened, and make the screen slack, the printing accuracy drops.
- Screen printing is a wet printing process and must take moisture absorption into account. Nylon absorbs up to 5% moisture and loses 10% to 20% strength. It will be stretched 26 to 40% before breaking, while the polyester mesh stretches 19 to 23% before breaking.
- Today, high-quality monofilament polyester has become used for screen printing, it is round and smooth, with high tensile strength. In wet conditions, its strength will not be reduced. In fact, it absorbs up to 0.8% moisture. The nylon screen printing mesh cloth only in the irregular surface of the printing or three-dimensional products will be used.
- When polyester (PES) yarn is used, it can be multifilament yarn for coarser screens, while for fine-mesh screens the monofilament yarn is used.

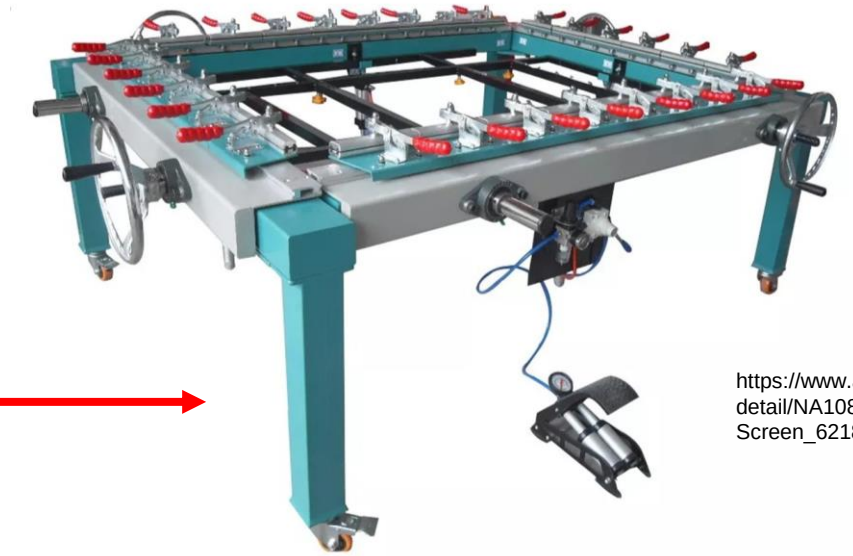
❑ Fineness of the screen (mesh)

- Different mesh sizes are used for different applications in the screen printing process. **Mesh** size is measured by how many threads of mesh there are crossing per square inch. For instance, a 70 mesh screen has 70 threads crossing per square inch. The higher the mesh count, the finer the threads and holes are in the screen. The size of the mesh has a lot to do with how detailed the image is and how thick is the used ink. If the image is having high details, a lower mesh screen is not recommended. The fine lines or dots in the image will simply fall through the holes in the mesh not giving a correct representation of what the image should be. Also if the thinner ink is used, it will flood through the larger holes and soak onto the substrate making image blurry as the ink bleeds. On the other hand, if a thicker ink is used (such as white) through the high of a mesh screen, barely any ink will print through the mesh.
- The fineness of the printing mesh can be, by some producers, also defined in number of threads per square centimeters, than it is defined as **raster**. Finally, **the choice of screen mesh depends on the fabric and design to be printed**.

- Some recommendations of choice of screen mesh:

	Threads/cm^{-1}	Open area/%
Terry toweling	19-34	47-43
Large blotches, furnishing fabrics	04-49	47-40
Large blotches on smooth fabric	43-55	43-39
Small motifs	49-62	41-34
Details and outlines on coarse fabrics	55-62	41-34
Outlines, half-tones, fine fabrics, synthetics	55-100	41-27

- Spread of the paste underneath the threads is essential for successful coverage of the fabric. The use of fine-mesh screens enables small quantities of low-viscosity paste to be applied, giving rapid but limited penetration, good colour yield, unbroken fine lines and geometrical objects.
- When **attaching to the frame**, the screen mesh is sized and stretched by use of **pneumatic tension equipment**.
- It is then attached to the frame using suitable adhesive.



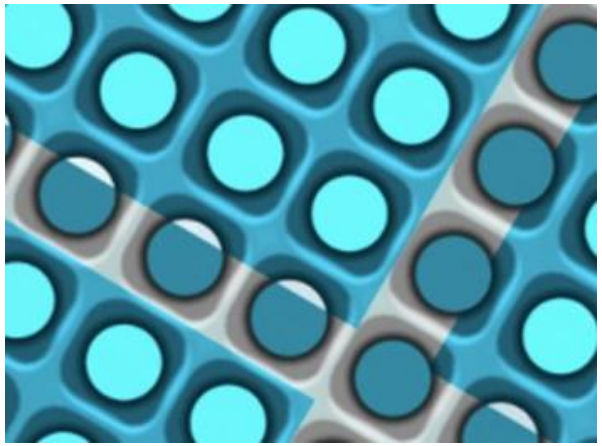
https://www.alibaba.com/product-detail/NA108-Pneumatic-120-150-cm-Screen_62185766522.html

❑ ROTARY SCREEN PREPARATION

- Rotary screens are usually made from nickel perforated plate. The perforations in the newest rotary screen plates can be **hexagonal** and **orthogonal**. The **hexagon-shaped perforation** are originally developed and are used from the beginning of the modern rotary printing technology. Those are honeycomb-like openings and are located in lines parallel to the axis of rotation of the cylinder (rotary screens). Also, the openings are designed so that, given the thickness of the plate, they are larger in diameter on the outside and smaller on the inside of the formwork. The fineness of such plates (screens) is also calculated in Meshes, and is defined by the number of hexagonal openings per line per inch of length.
- The **orthogonal screens** use a special technique with an orthogonal hole raster, to make sure moiré effects don't occur during printing. Those are recommended for designs containing a lot of geometric features or halftones.

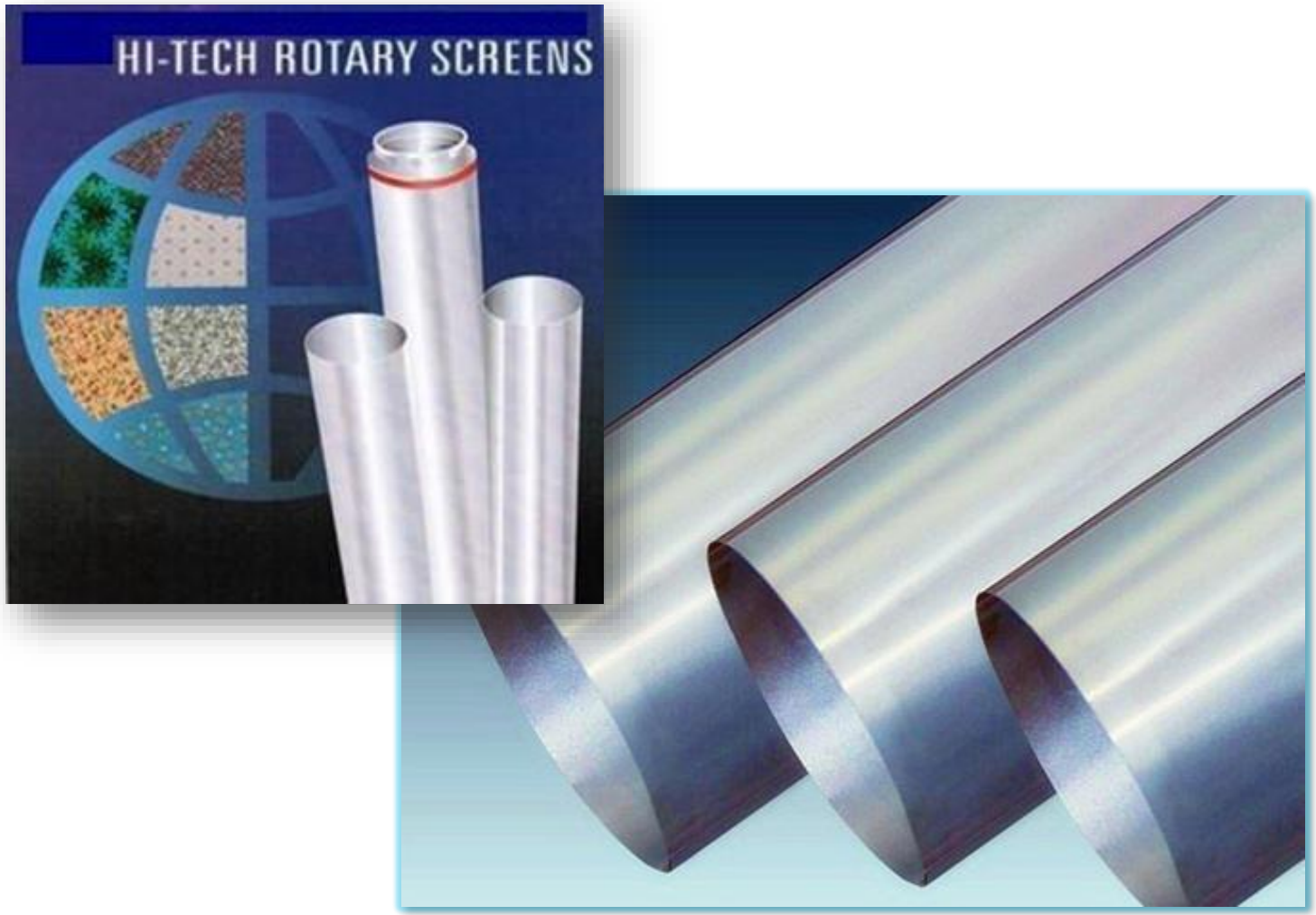
https://blog.spgprints.com/difficult-designs-in-rotary-screen-printing-and-the-solution

❑ Hexagonal holes



https://blog.spgprints.com/difficult-designs-in-rotary-screen-printing-and-the-solution

❑ Orthogonal holes



https://www.indiamart.com/hitechscreens/rotary-screen.html

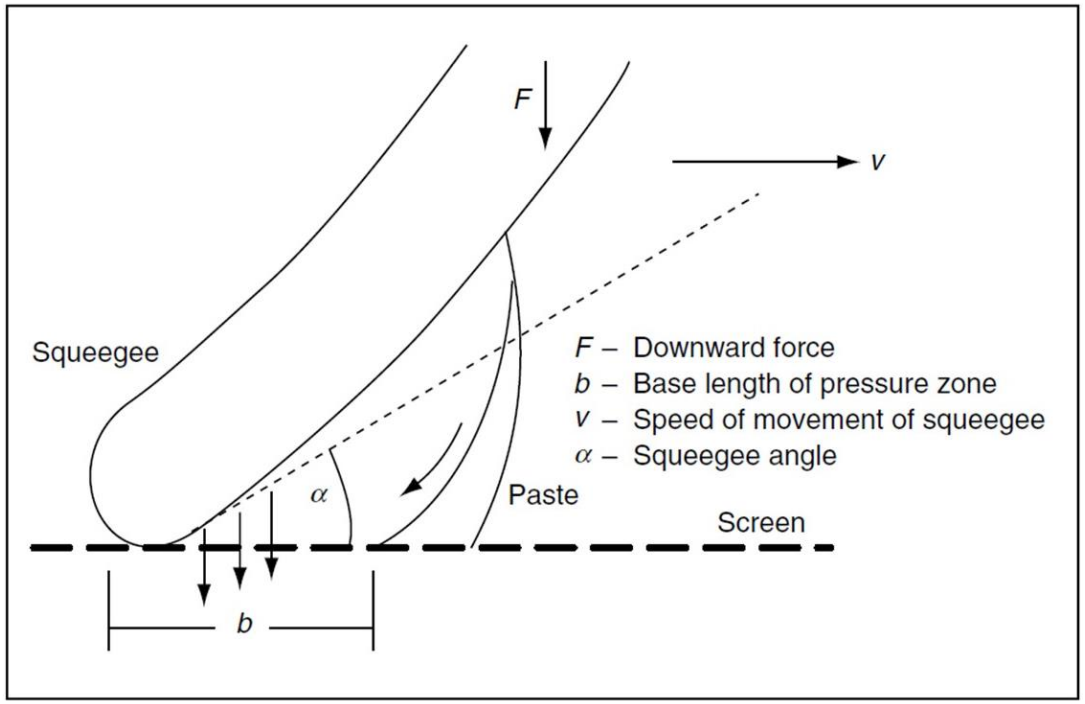
- Nickel rotary screens for textile printings

❑ THE AMOUNT OF PASTE PRINTED ONTO MATERIAL, FLOW AND PRINT MECHANISM

The amount of print paste passing through the screen will depend on:

- ✓ The mesh (threads per inch) or raster (threads per cm) in general - coarse mesh allow more paste, while the finer one allow a smaller amount of paste to pass through
- ✓ The fraction of open area between the warp thread and weft thread of the screen; This depends not only on the fineness of the screen, but also on the yarn diameter
- ✓ Hardness and cross section of squeegee;
- ✓ Hardness and firmness of the printing table;
- ✓ Viscosity of printing paste;
- ✓ The number of passages of the squeegee; It is recommended to use 2 to 4 passages for a single impression
- ✓ The angle of the squeegee and the force of pressure
- ✓ The passage speed of the squeegee

❑ Hydrodynamic pressure in the paste wedge



- ❑ The downwards force F on the squeegee is necessary to produce the required angle and to prevent the blade being lifted off the screen, but otherwise has little effect on the hydrodynamic pressure in the paste wedge except that due to any distortion of the screen which may alter the effective squeegee angle.

- ❑ The hydrodynamic pressure is increased by:
  - ✓ decreasing the squeegee angle (hence sharp squeegee blades apply less colour than rounded ones)
  - ✓ increasing the base length of the pressure zone *b*
  - ✓ increasing the speed of the movement of the squeegee *v*
  - ✓ Increased paste viscosity η
  - ✓ Reduced screen-pore radius *r*

❑ Flow of paste through screen pores

$$Q = \frac{Pr^4}{8\eta l}$$

From the book: Textile Printing
Editor: Leslie W. C. Miles
 ISBN 0 901956 79 1

- ❑ The flow through holes in the screens can approximately be described by the Poiseuille relationship (equation showed).
- ❑ Q is the quantity of the paste flowing through hole of length l (related to the screen thickness) and radius r, and P is the pressure drop across the hole.
- ❑ In the addition to the pore size, the percentage of open area (porosity) of the screen has direct effect on the quantity of paste flowing through a screen, more open screens allowing more paste to pass through.