Textile chemistry

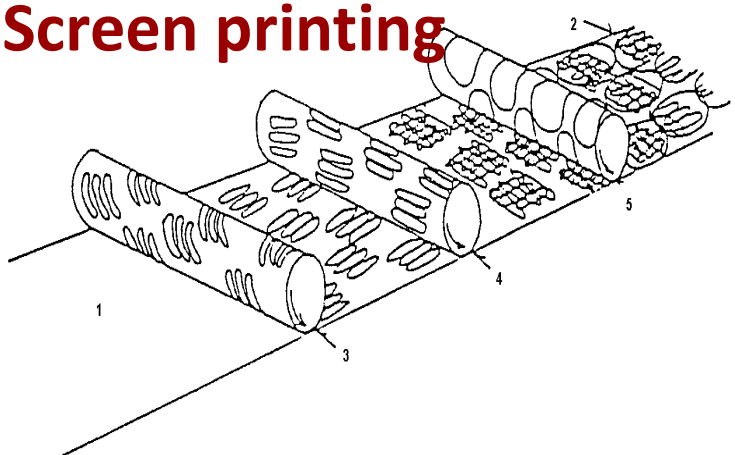
Textile Printing

Jakub Wiener

Textile printing

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, whereas in dyeing proper the whole fabric is uniformly covered with one colour, in printing one or more colours are applied to it in certain parts only, and in sharply defined patterns

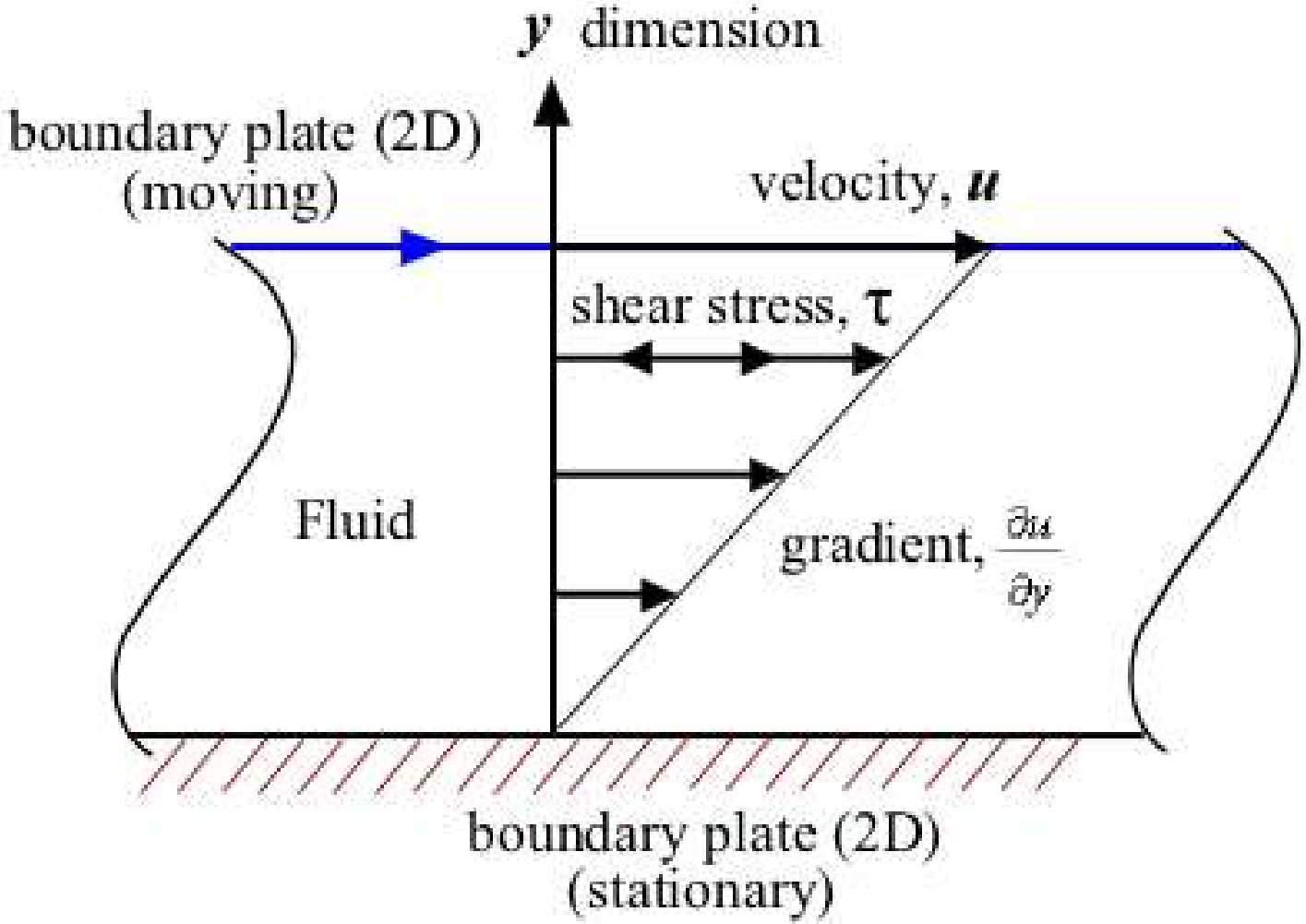
Screen printing



Printing = local dyeing, but …

pattern

Viscosity


y dimension
boundary plate (2D)
(moving)
velocity, u
shear stress, τ
Fluid
gradient, ∂u/∂y
boundary plate (2D)
(stationary)

WATER

TOOTHPASTE

on textile?

Dynamic viscosity and absolute viscosity are synonymous - symbol eta (η) or mu (μ).

Physical unit: pascal-second (Pa·s), is identical to 1 $kg \cdot m^{-1} \cdot s^{-1}$.

If a fluid with a viscosity of one Pa·s is placed between two plates, and one plate is pushed sideways with a shear stress of one pascal, it moves a distance equal to the thickness of the layer between the plates in one second.

Kinematic viscosity

In many situations, we are concerned with the ratio of the viscous force to the inertial force, the latter characterised by the fluid density ρ.

kinematic viscosity (ν): ratio of μ (the dynamic viscosity) and ρ (the density)

Example: **viscosity of water**

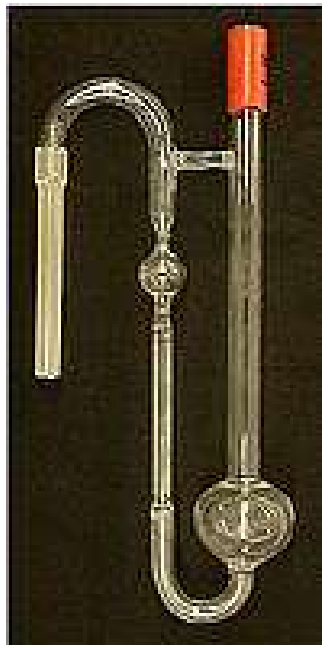
Because of its density of $\rho = 1\ g/cm^3$, and its dynamic viscosity is near 1 mPa·s, the viscosity values of water are, to rough precision, all powers of ten:

$\mu = 1\ mPa \cdot s = 10^{-3}\ Pa \cdot s = 1\ cP$

$\nu = 1\ cSt = 1\ mm^2/s$

Viscosimetry

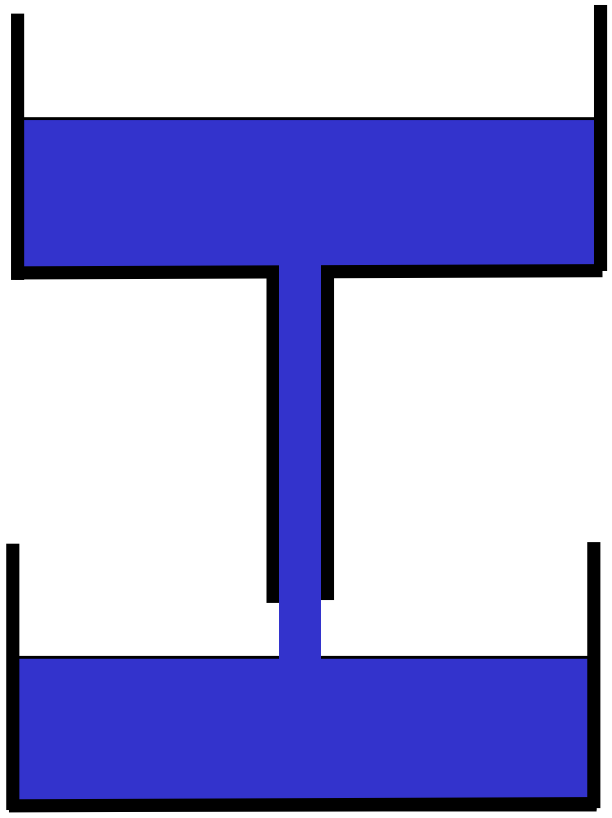
average polymerization degree of polymer in solution

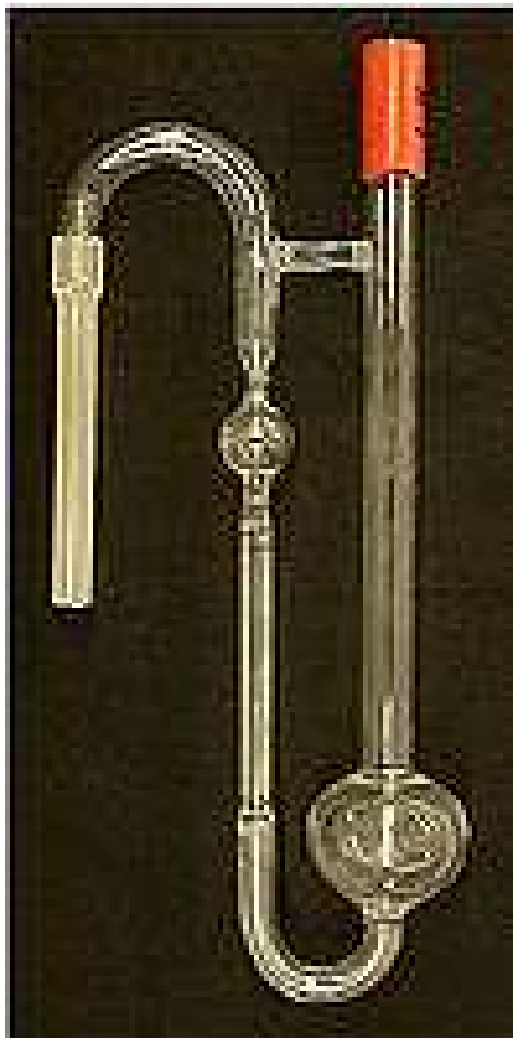


testing of printing pastes

Viscosimetry

average polymerization degree of polymer in solution (according degradation fiber)

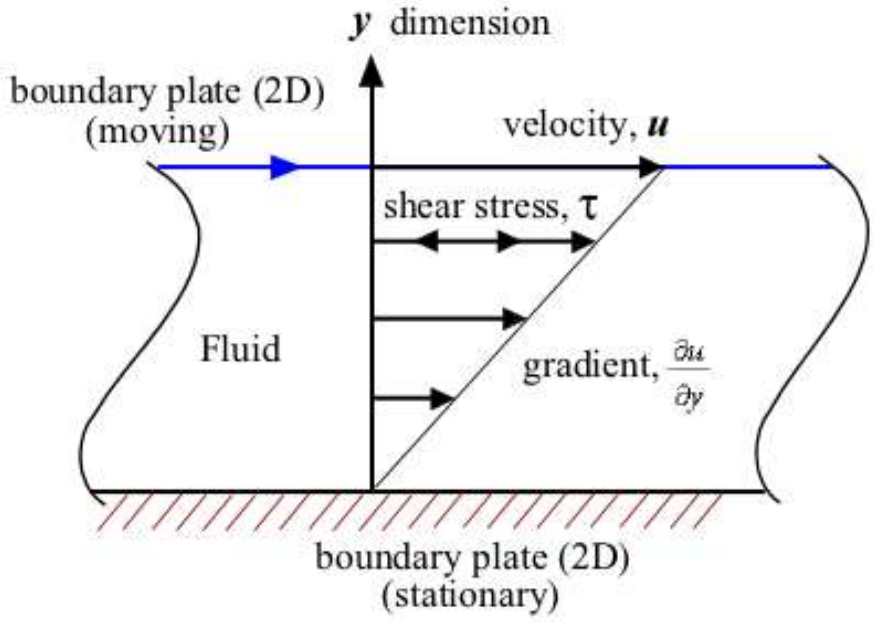




Analysis of rheological behavior of printing pastes

Viscosimetry

testing of printing pastes



Printing history

Textile printing is an ancient art form found on cloth in Egyptian tombs dating to about 5000 B.C.

Greek fabrics dating from the 4th century B.C. have also been found.

Block prints were first seen imported from India to the Mediterranean in 5th C B.C.

History of printing	
Woodblock printing	200 CE
Movable type	1040
Printing press	1377
Etching	c. 1515
Mezzotint	1642
Aquatint	1772
Lithography	1796
Chromolithography	1837
Rotary press	1843
Hectograph	1869
Offset printing	1875
Hot metal typesetting	1884
Mimeograph	1886
Photostat and Rectigraph	1907
Screen printing	1910
Spirit duplicator	1923
Xerography	1938
Phototypesetting	1949
Inkjet printing	1951
Dye-sublimation	1957
Dot matrix printer	1968
Laser printing	1969
Thermal printing	c. 1972
3D printing	1984
Digital press	1993

Printing

- Printing can also be defined as localized dyeing.
- Defined as the application of dye or pigment in a different pattern on the fabric and by subsequent after treatment of fixing the dye or pigment to get a particular design.
- Sometimes a printed fabric can be identified by looking at the back side of fabric where there is no design or color as face side.
- In cotton, dyes like vat, reactive are used
- In manmade, dyes like disperse and cationic are used

DuPont™ *Artistri*™

Technology for Digital Textile Printing

Global Textile Printing Market

> 26 billion m² textiles screen printed each year

Printing

- Roller Printing
- Flat (Silk) Screen Printing
- Rotary Screen Printing
- Block Printing
- Heat Transfer Printing
- Dye Sublimation Printing
- Resist Printing

DIFFERENT STYLES OF PRINTING

There are three basic approaches to printing a color on a fabric

1. DIRECT PRINTING
2. DISCHARGE PRINTING
3. RESIST PRINTING

DIRECT PRINTING

- In this type of printing dye is applied onto the fabric by carved block, stencil, screen, engraved roller etc.
- The dye is imprinted on the fabric in paste form and any desired pattern may be produced
- Example:-Block Printing, Roller Printing, Screen Printing etc.

Printing of Cotton Fabric with Reactive Dye

- **Style of Printing:**
  Direct style of fabric.

Method of Printing:
Screen method.

Thickener Use:
Na-Alginate, Gum tragacanth, Guar Gum,British Gum etc.

- **Printing Paste Recipe:**

Procion -M ----------10-80 parts
Urea----------50-75 parts
thickener paste ----------400 parts
Regist salt----------10 parts
Sodium bicarbonate----------25 parts
Hot water----------245-420 parts
Total = 1000 parts

Printing of Cotton Fabric with Reactive Dye

Process Sequence:

Thickener Preparation

↓

Printing paste preparation

↓

Printing

↓

Drying

↓

Steaming (102-105 degree C temp. about 5-10 minute)

↓

Soaping & Washing

↓

Drying

Printing of Cotton Fabric with ***Vat*** Dye

Style of Printing:
Direct style of fabric.

Method of Printing:
Screen method.

Thickener Use:
British Gum.,Starch,Gum tragacanth.Na-Alginate.

Print Paste Recipe:
Vat dye ----------100-125 gm
Glycerine ----------50-75 gm
Thickener paste----------500 gm
Potassium carbonate ----------80-120 gm
Sodium hydroxymethanesulfinate ----------60-100 gm
Water ----------210-250 gm

Rongalitte = Sodium hydroxymethane**sulfinate**

- This salt is prepared from sodium dithionite and formaldehyde:
- $Na_2S_2O_4 + 2\ CH_2O + H_2O \rightarrow HO\text{-}CH_2\text{-}SO_3Na + HO\text{-}CH_2\text{-}SO_2Na$This reaction proceeds quantitatively, such that dithionite can be determined by its conversion to Rongalite, which is far less O_2-sensitive and thus easier to handle.
- The hydroxymethanesulfinate ion is unstable in solution towards decomposition to formaldehyde and sulfoxylate ion. Addition of at least one equivalent of formaldehyde pushes the equilibrium towards the side of the adduct and reacts further to give the *bis*-(hydroxymethyl)sulfone. Such solutions are shelf-stable indefinitely.

Printing of Cotton Fabric with *Vat* Dye

Process Sequence:

Thickener Preparation
↓
Printing paste Preparation
↓
printing
↓
Drying
↓
steaming (At 100-102degree C temp. about 3-5 minute)
↓
Oxidation(By air or By chemical)
↓
Washing
↓
Drying

Printing of Polyester Fabric with Disperse Dye

Style of Printing:
Direct style of fabric.

Method of Printing:
Screen method.

Thickener Use: Guar Gum.Starch.CMC

Printing Recipe:

Disperse dye (liquid)----------50-100 gm
Thickener paste ----------984-790 gm
Di-ammonium sulphate----------5 gm
Sodium chlorate----------1 gm
Water ----------50-140 gm

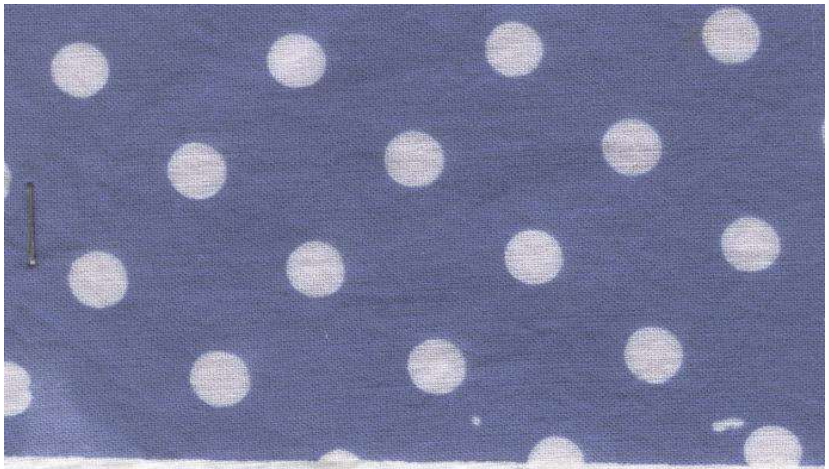
Printing of Polyester Fabric with Disperse Dye

Process Sequence:

Fabric preparation
↓
Thickener Preparation
↓
Printing paste Preparation
↓
Printing
↓
Drying
↓
Fixation (Steaming /hot air/thermo-fixation)
↓
Reduction cleaning
↓
Soaping (By 1g/l soap at 60 degree C about 15 minute)
↓
Washing
↓
Drying

Resist Printing

- In addition to normal printing techniques, there are special techniques available to the printer to produce unique effects on fabric.
- The first of these is resist printing. In this method, the fabric is first printed in a design with a chemical that resists dye. The fabric is then dyed.
- The resist will leave the fabric white



Resist Printing

Discharge printing is one method of resist printing and involves using a chemical paste. It must be used with a 'reactive dye' as a ground colour for the process to work. It also has to be 'cured' or fixed with steam so the dye reacts with the fabric and causes a colour reaction. Discharge printing produces the brightest, lightest prints on dark-coloured garments and can be very striking. This method can only be used on natural fibres and fabrics that will discharge colour.

Another method of resist printing is Batik. Natural materials such as cotton or silk are used as they absorb the wax that is applied in the dye resisting process. The fabrics must be of a high thread count (densely woven) for best results.

RESIST PRINTING

- In this method bleached fabric are printed with a resist paste (a resinous substance that cannot be penetrated when the fabric is immersed in a dye).
- The dye will only affect only the parts that are not covered by the resist paste .
- After the fabric has passed through a subsequent dyeing process the resist paste is removed, leaving a pattern on a dark background

Resist Printing

- **Wax or paste**: melted wax or some form of paste is applied to cloth before being dipped in dye. Wherever the wax has seeped through the fabric, the dye will not penetrate. Sometimes several colors are used, with a series of dyeing, drying and waxing steps. The wax may also be applied to another piece of cloth to make astencil, which is then placed over the cloth, and dye applied to the assembly; this is known as **resist printing**.

Resist Printing

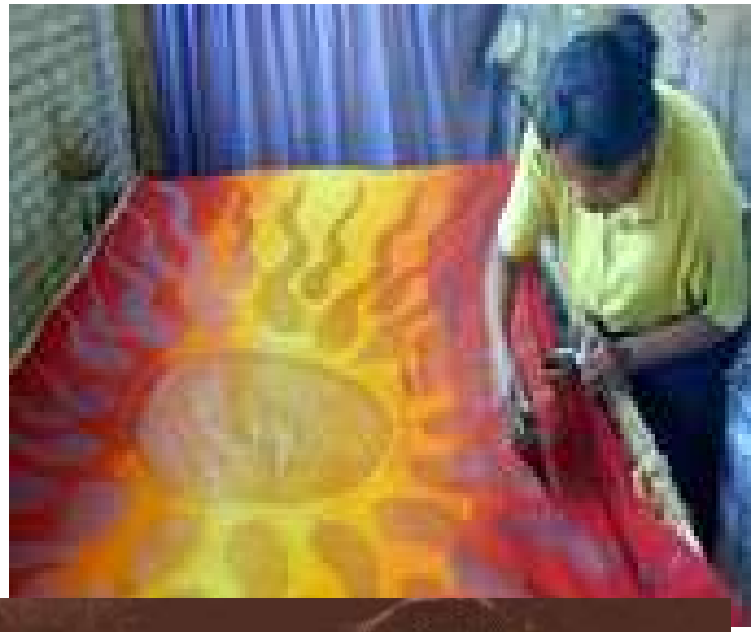
- **Paper stencils** may also be used; another type of resist printing. The same method is used in art in printmaking, in one form of screenprinting.
- **Mechanical**: the cloth is tied,stitched, or clamped using clothespegs or wooden blocks to shield areas of the fabric.

Resist Printing

- **Chemical**: a modern textile printing method, commonly achieved using two different classes of fiber reactive dyes, one of which must be of the vinyl sulfone type. A chemical-resisting agent is combined with dye Type A, and printed using the screenprint method and allowed to dry. A second dye, Type B, is then printed overtop. The resist agent in Type A chemically prevents Type B from reacting with the fabric, resulting in a crisp pattern/ground relationship

BATIK PRINTING

- Originated on island of Java and is a cottage based industry.
- Batik is derived from word “AMBATIK”
- The resist-dyeing process, whereby designs are made with wax on a fabric which is subsequently immersed in a dye to absorb the color on the unwaxed portions, is known as batik printing.
- Special feature is the fine lines of color running irregularly across the fabric.



BATIK PRINTING

- ADVANTAGES
- Gives a good artistic effect
- Cheap printing
- Greater artistic design
- Fabric has a rich and graceful appearance

- DISADVANTAGES
- Laborious
- Time taking
- Cracking effect
- Dye should be applied at low temperature than wax.

TIE & DYE

- It is same as that of batik printing but here the dye is resisted by knots that are tied in the cloth before it is immersed in dye bath.
- The outside of the knotted portion is dyed, but inside is not penetrated if the knot is firmly tied.
- This gives a characteristic blurred or mottled effect .

TIE & DYE

- ADVANTAGE
- Interesting design created on fabric
- No m/c cost is there

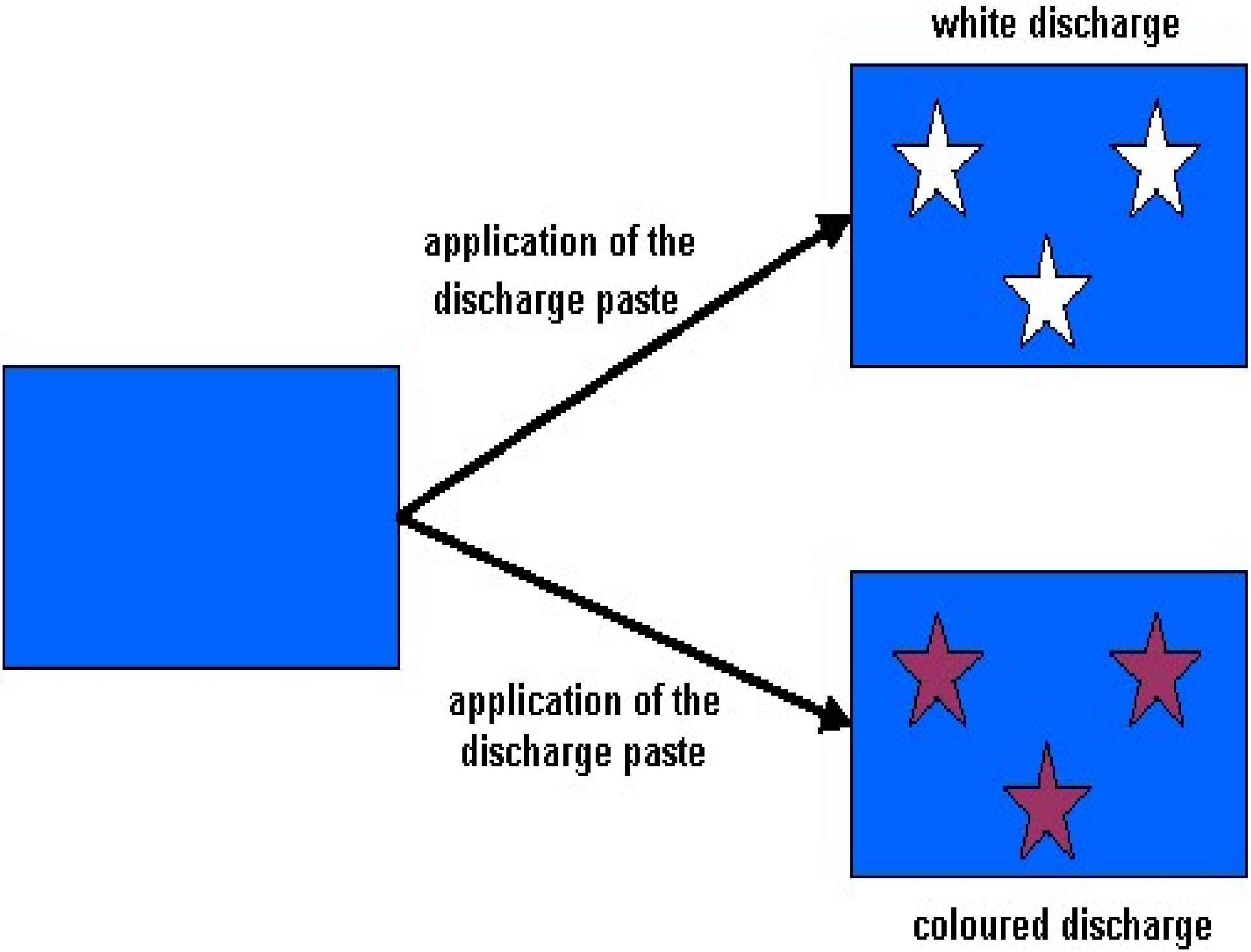
- DISADVANTAGE
- Costly
- Laborious
- Time taking
- Skilled labour required

Discharge Printing

- A second unique process is known as discharge printing. In this method, the fabric is dyed to the required ground color. Next, the fabric is printed with a chemical that selectively destroys the dye. This leaves a white “discharge” design in the ground color.

DISCHARGE PRINTING

- In this method the fabric is dyed and then printed with a chemical that will destroy the color in designed areas.
- Sometimes the base color is removed and another color printed in its place.


white discharge
application of the
discharge paste
application of the
discharge paste
coloured discharge

Flock Printing

- A third printing technique is known as flock printing. Here an adhesive is printed in a design on the fabric. Next, the fabric is covered with cut fiber known as flock.
- The fiber is then embedded in the adhesive by one of various techniques such as compressed air, the shaking process, or the electrostatic process.

Flock Printing

Environmental Issues

Printing techniques are renowned for their damage to the environment and the health of the workforce producing them. There is a lot of washing preparation done to the fabric before can be printed on and this sends chemicals into the air and water and pollutes the outside environment. A typical process will often include sequestrates, alkalis, bleaching agents, stabilisers, catalysts, crease-resisting agents, acid dyes, exhausting agents, soaping agents and softeners. Probably 20–30 chemicals per process. Harsh and hazardous chemicals are used in the dyeing and printing methods of fabrics and toxins like carbon monoxide, carbon dioxide, sulphur dioxide and zinc oxides carcinogenic are commonly found in these processes. Transfer printing is the most environmentally friendly form of printing onto fabric and also the most cost effective.

Environmental Issues

Generally, the auxiliaries used for printing are the same as those used in dyeing with a dye bath. These types of auxiliaries include:

Oxidizing agents (e.g. m-nitrobenzenesulphonate, sodium chlorate, hydrogen peroxide)

Reducing agents (e.g. sodium dithionite, formaldehyde sulphoxylates, thiourea dioxide, tin(II) chloride)

Wetting agents (nonionic, cationic, anionic)

Discharging agents for discharge printing (e.g. anthraquinone)

Humectants (urea, glycerine, glycols)

Carriers: (cresotinic acid methyl ester, trichlorobenzene, n-butylphthalimide in combination with other phthalimides, methylnaphthalene)

Retarders (derivatives of quaternary amines, leveling agents)

Resist agents (zinc oxide, alkalis, amines, complexing agents)

Metal complexes (copper or nickel salts of sarcosine or hydroxyethylsarcosine)

Softeners

Defoamers, (e.g. silicon compounds, organic and inorganic esters, aliphatic esters, etc.)

Resins

DIFFERENT TYPES OF PRINTING

- BLOCK PRINTING
- PEROTTINE PRINTING
- ROLLER PRINTING
- STENCIL PRINTING
- FLAT-SCREEN PRINTING
- ROTARY –SCREEN PRINTING
- TRANSFER PRINTING

- DIGITAL PRINTING

BLOCK PRINTING

Block printing is a traditional process dating back to India in the 12th century. Wooden blocks made of seasoned teak in different shapes and sizes are cut by trained craftsmen. Each block has a wooden handle and two or three holes drilled into the block to the passage of air and release of excess print paste.

Fabric is stretched over a printing table and fastened with small pins. Printing starts from left to right, first the colour is evened out in the tray and then the block is dipped in. Then the block is applied to the fabric with careful registration and pressure is applied.

BLOCK PRINTING

Multiple colour designs are labour intensive and require a lot of skill to register the prints exactly.

Colour variation is hard to avoid with this method as print ink can vary in quality of depth or colour.

The Japanese took wood block printing to new levels and developed unparalleled skill in the construction of fine delicate prints.

BLOCK PRINTING

- It is the oldest and simplest way of printing
- In this method a wooden block with a raised pattern on the surface was dipped into the printing colorant and then pressed face down on to fabric.
- The desired pattern was obtained by repeating the process using different colors.
- Generally the wooden block is carved out of hand
- Printing is done manually

BLOCK PRINTING

Design for a hand woodblock printed textile, showing the complexity of the blocks used to make repeating patterns. 1883

Evenlode block-printed fabric.

BLOCK PRINTING

BLOCK PRINTING

BLOCK PRINTING

BLOCK PRINTING

ADVANTAGES

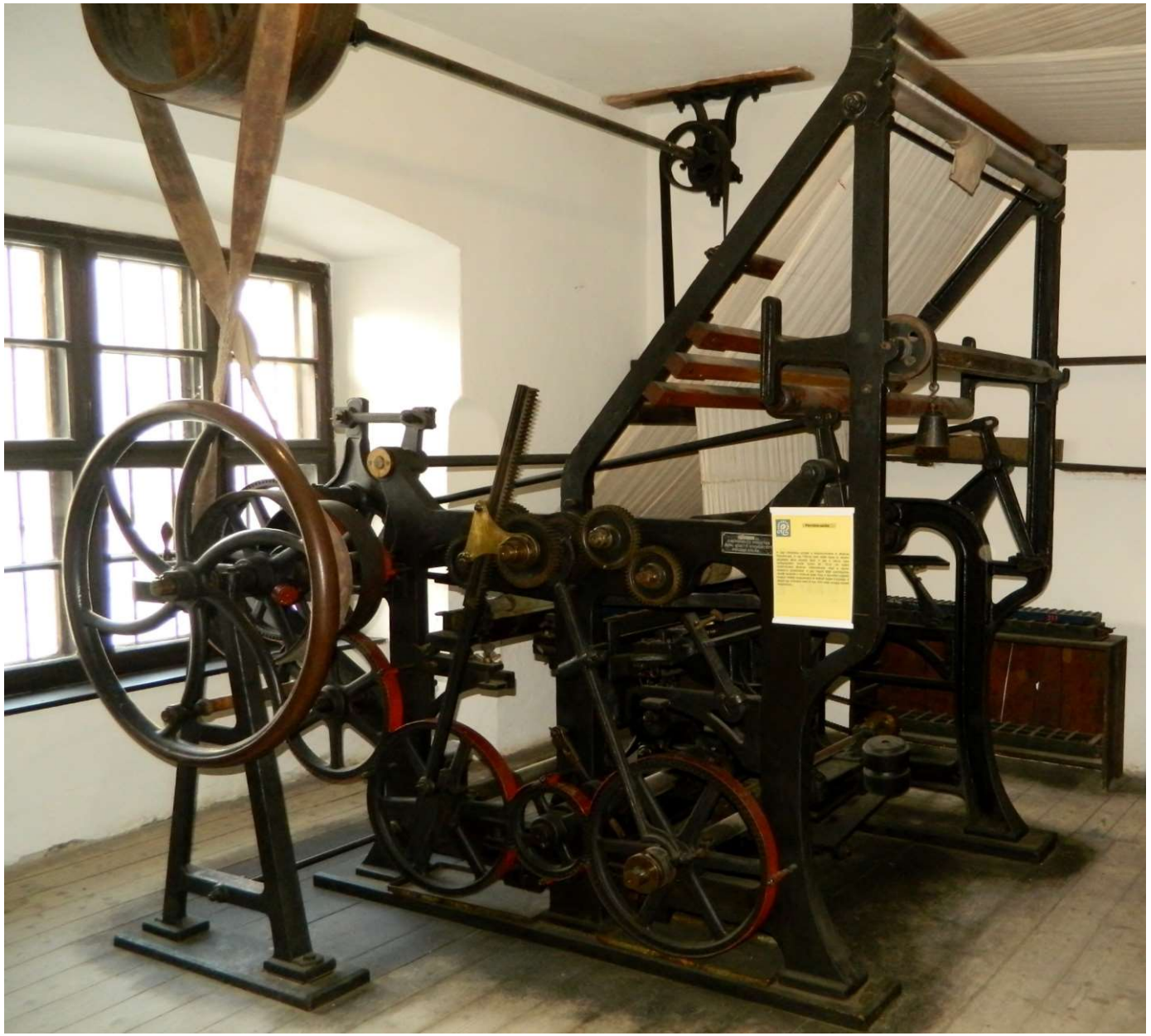
1. **Simple method of printing**
2. **No expensive equipment required**
3. **No limitation in repeat of size of style**
4. **Prints produced have great decorative value and stamp of craftsmanship**

DISADVANTAGES

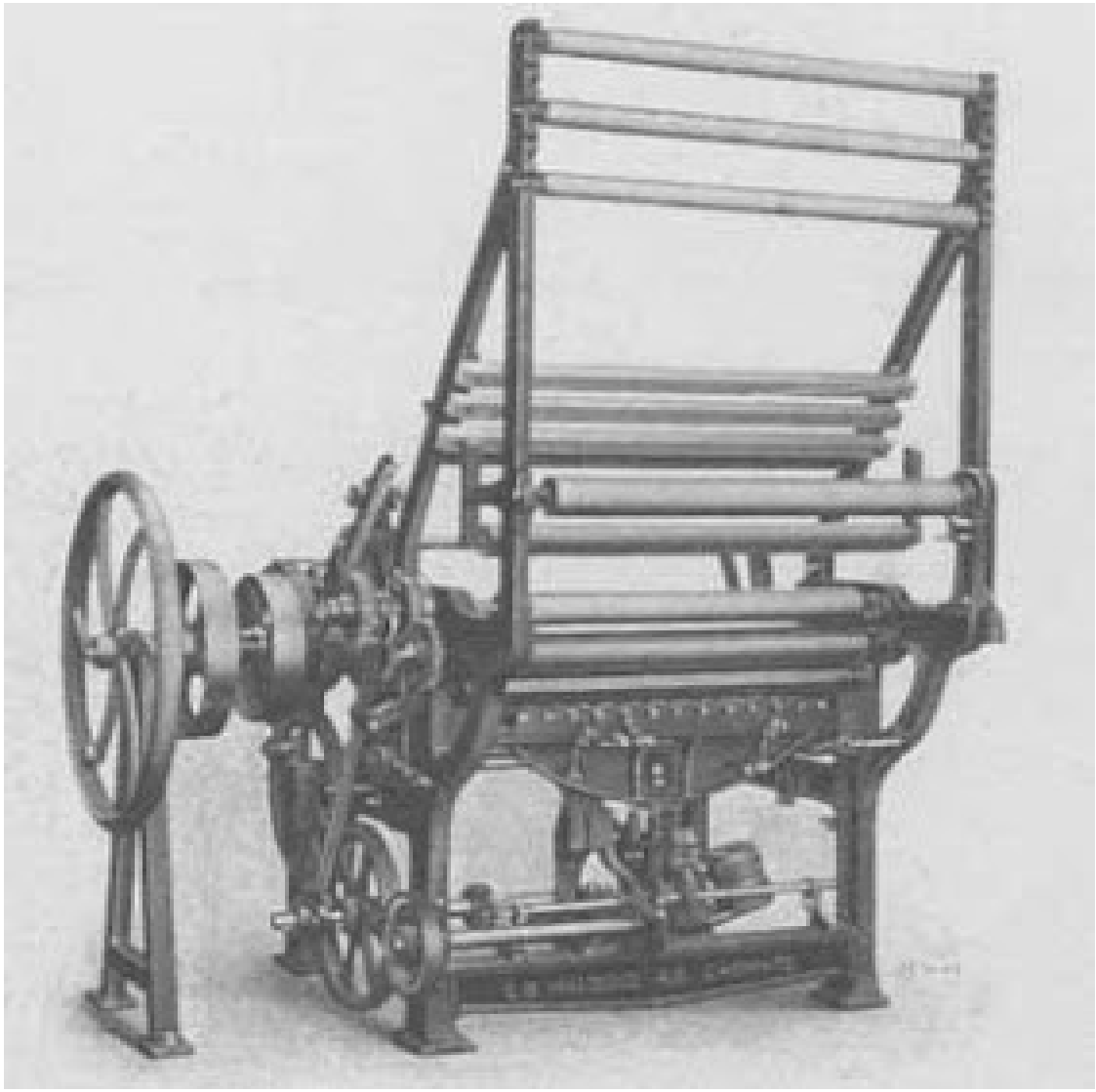
1. **Involves much manual work**
2. **Method is slow and therefore low output**
3. **Good skilled labors needed for multi color design**
4. **Fine and delicate designs hard to produce**

Perrotine printing

Machines also made an impact on block printing; in 1834, Perrot of Rouen invented a mechanical block printing machine, now known as a perrotine, that sped up the process considerably.



Perrotine printing



ROLLER PRINTING

This process involves a print paste (like a thick paint) that is applied to an engraved roller, and the fabric is guided between it and a central cylinder. The pressure of the roller and central cylinder forces the print paste into the fabric. Because of the high quality it can achieve, roller printing is the most appealing method of printing designer and fashion apparel fabrics.

ROLLER PRINTING

Long runs of the same fabric design are produced on a roller print cylinder machine operating at speeds between 50 and 100 yards a minute. As many as 10 different colors can be printed in one continuous operation, but each colour must have a separate roller.

The design is cut into the surface of copper rollers; by varying the depth of the engraving on the roller the shade depth can be altered. Sharpness of line and fine detail can be achieved this way. A typical printing machine has a large padded drum or cylinder, which is surrounded by a series of copper rollers, each with its own dye trough and doctor blade that scrapes away excess dye.

ROLLER PRINTING

The tubular screens rotate at the same velocity as the fabric, the print paste is distributed inside a tubular screen, which is forced into the fabric as it is pressed between the screen and a printing blanket (a continuous rubber belt). It picks up colour from the engraved area of each roller in sequence. The printed cloth is dried immediately and conveyed to an oven that sets the dye. Knitted fabric is mostly printed in this method as it does not pull or stretch the fabric.

ROLLER PRINTING

- It is the machine method of printing designs on cloths by engraved rollers.
- The design is engraved on the surface of a metal roller, to which dye is applied, and the excess is scraped off the roller's surface, leaving dye in the engraved sections. When it rolls across the fabric, the dye on the roller transfers to the fabric.

ROLLER PRINTING

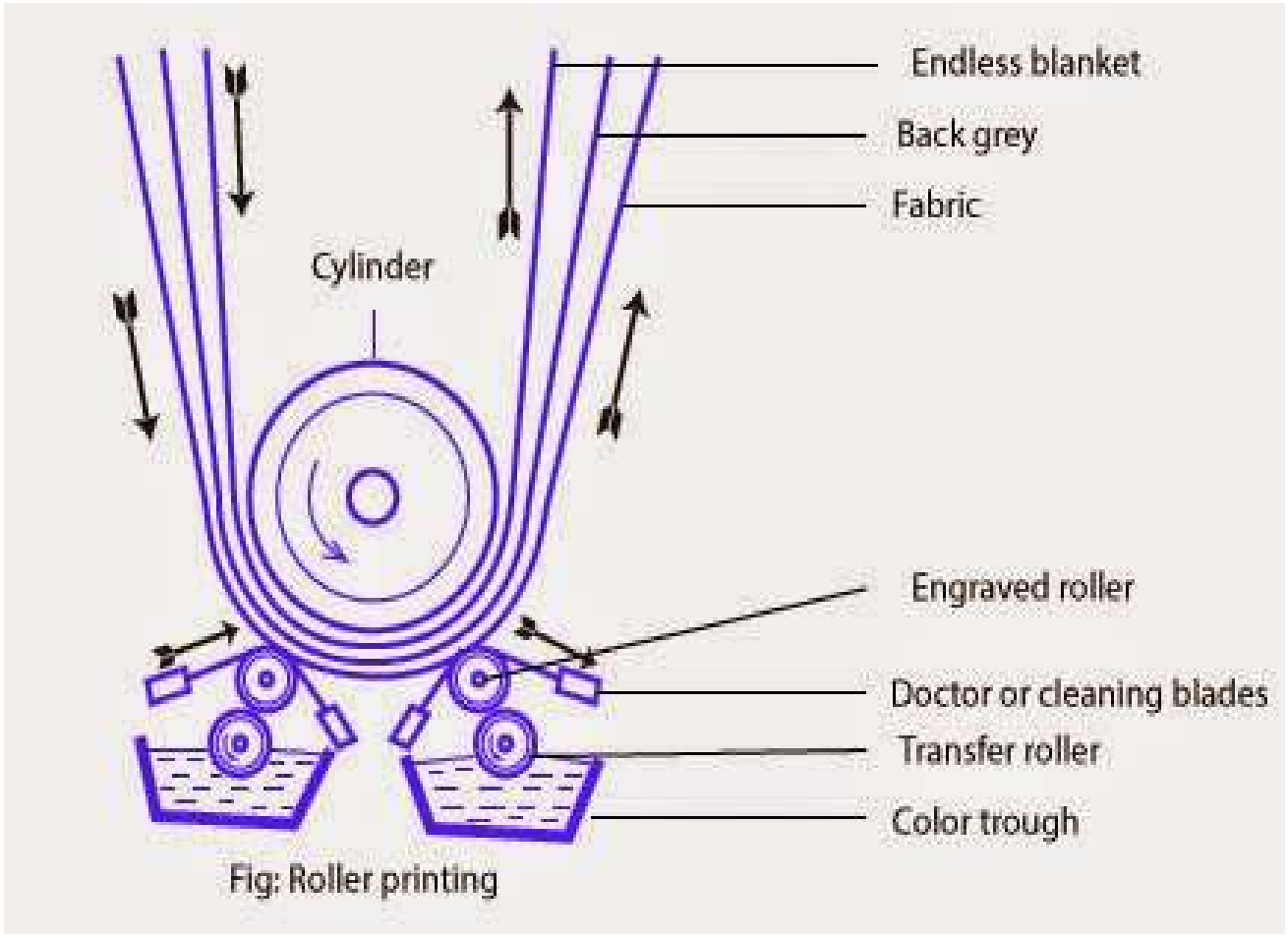
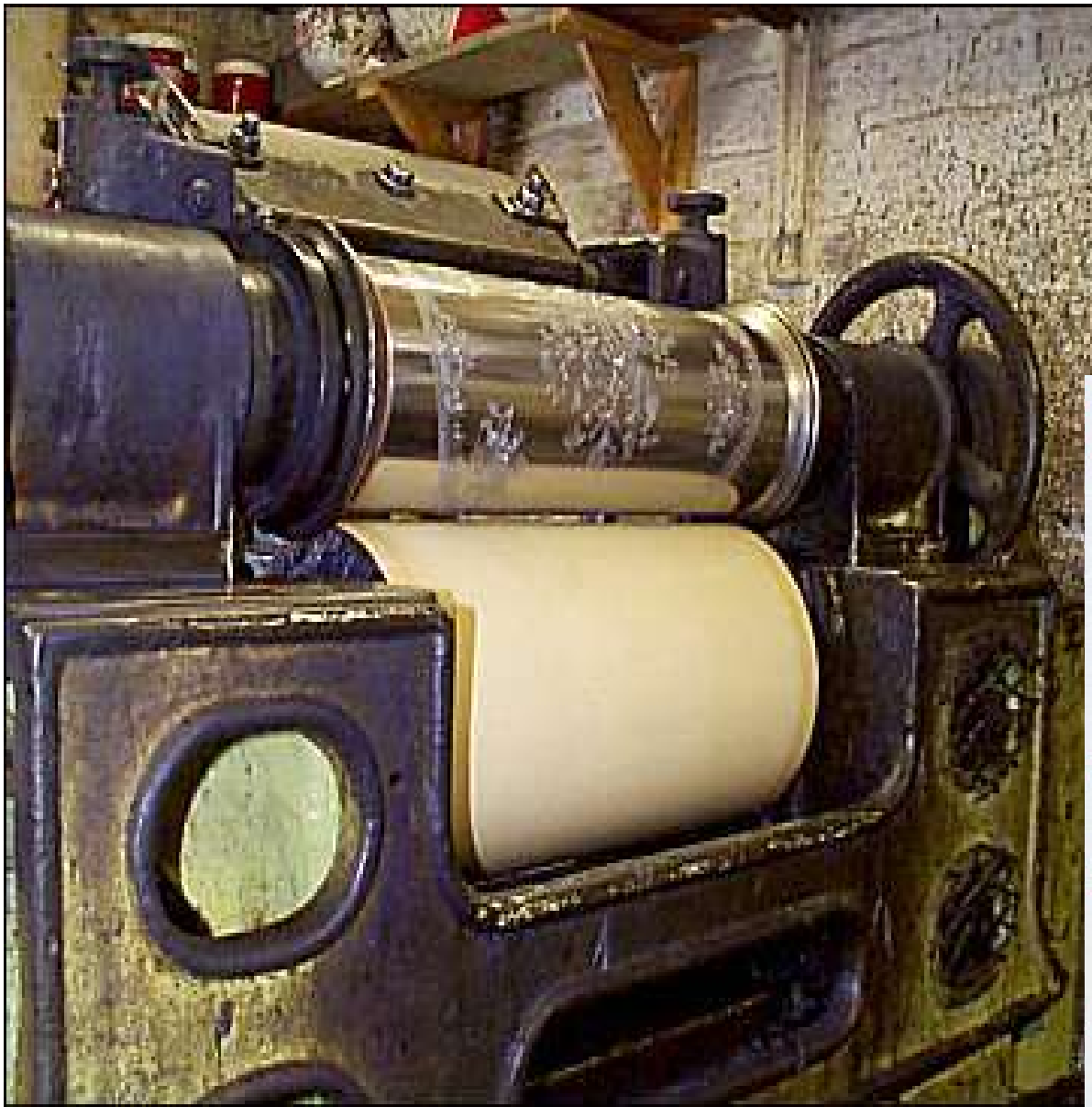
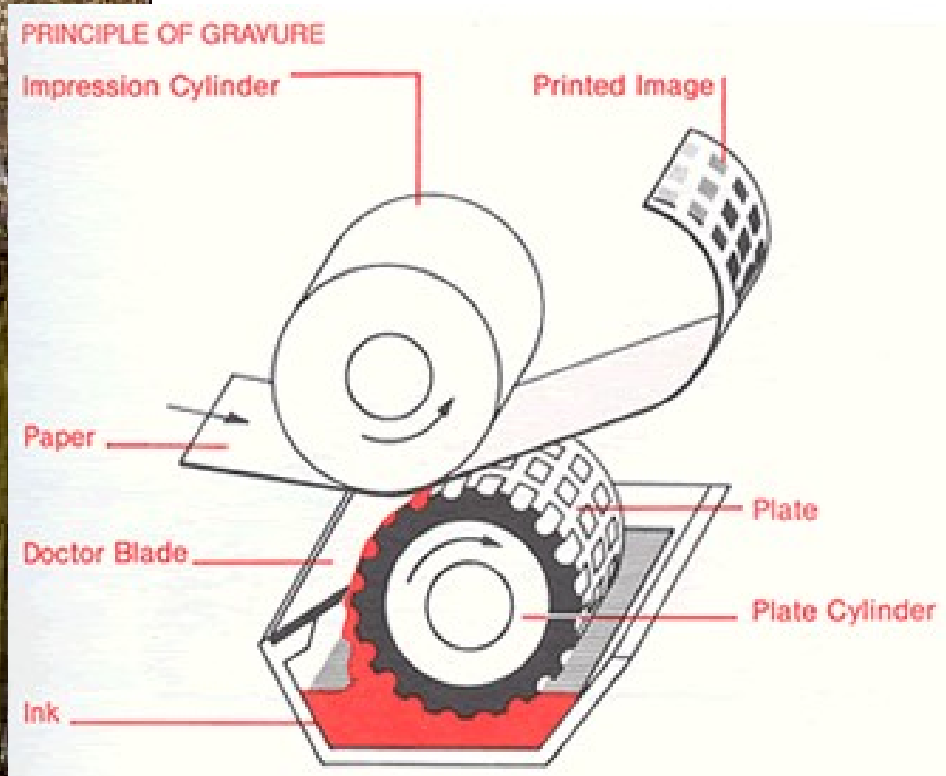


Fig: Roller printing

Roller printing is especially suited for printing large batches. Speeds can amount to approximately 100 meters per minute. Moreover, roller printing can be used for very fine printing.

ROLLER PRINTING





ROLLER PRINTING

Entgraved roller

ROLLER PRINTING

ROLLER PRINTING

ADVANTAGES

1. Large quantities of fabric at the rate of 914-3658m per hour can be printed.
2. Faulty joints or joint marks are absent.
3. Fine sharp outlines and good prints can be obtained which is difficult to get in block printing.

DISADVANTAGES

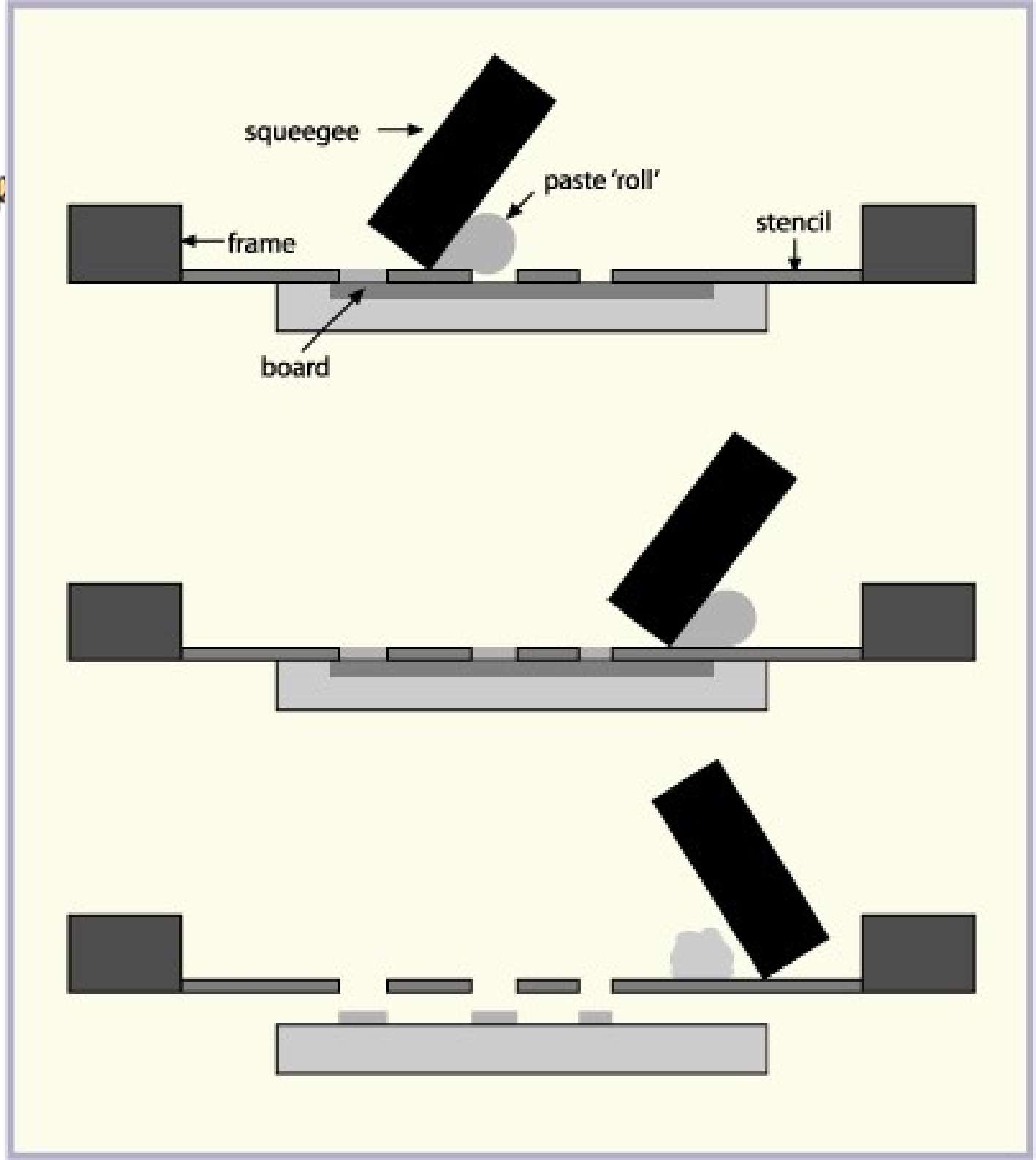
1. Not economical for short run of fabrics.
2. Difficult to produce blotch designs.
3. Repeat of design limited to the size of the rollers.
4. Setup cost of roller printing is high

STENCIL PRINTING

- It is one of the oldest way of printing.
- In it color is applied to the fabric by brushing or spraying the interstices of a pattern cut out from a flat sheet of metal or waterproof paper or plastic sheet or laminated sheet.
- A stencil is prepared by cutting out a design from a flat sheet of paper, metal, or plastic.

In textile printing is stencil from paper or polymer film

Now: home work or art



stencil prints

STENCIL PRINTING

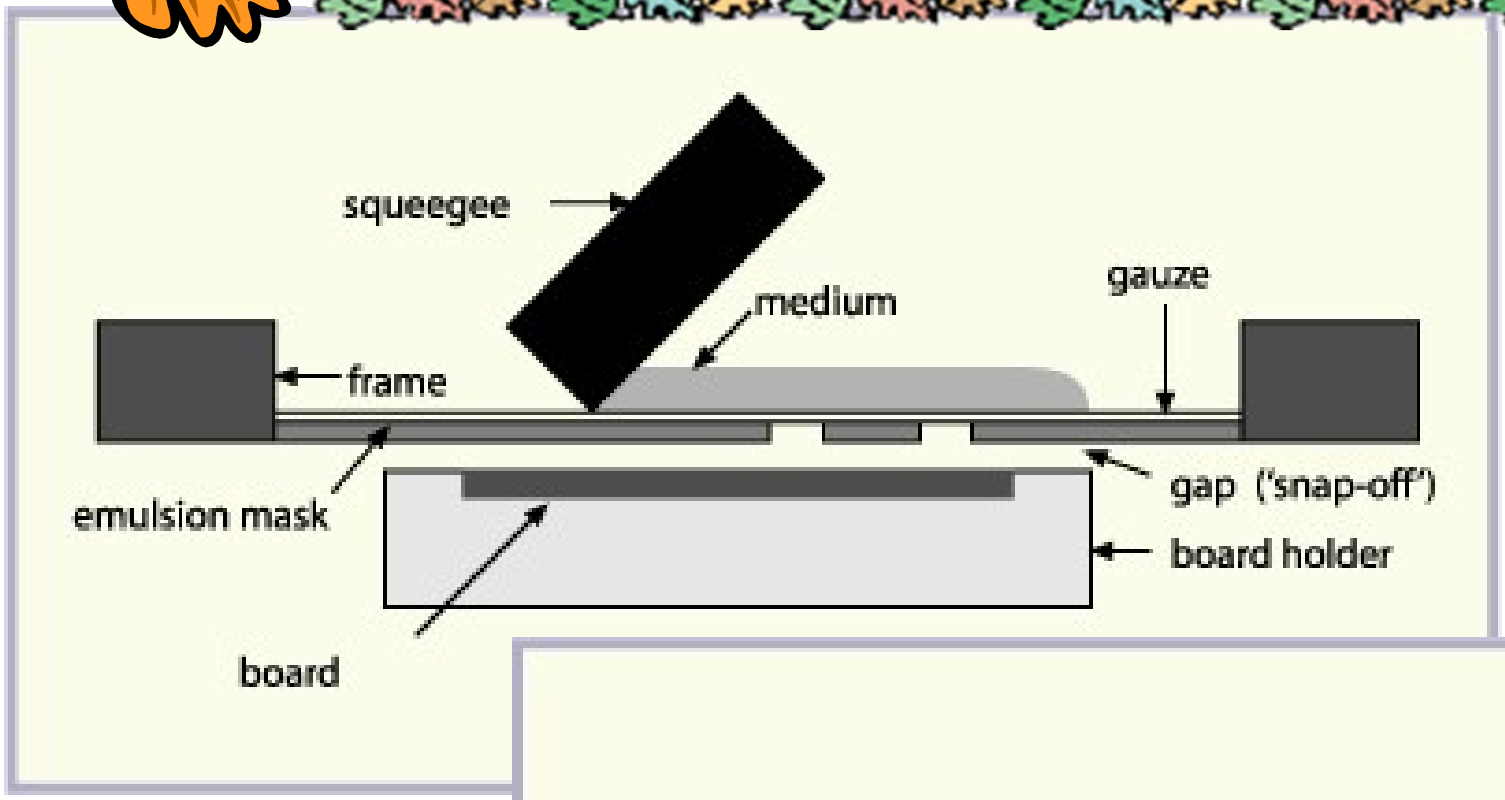
- **ADVANTAGES**

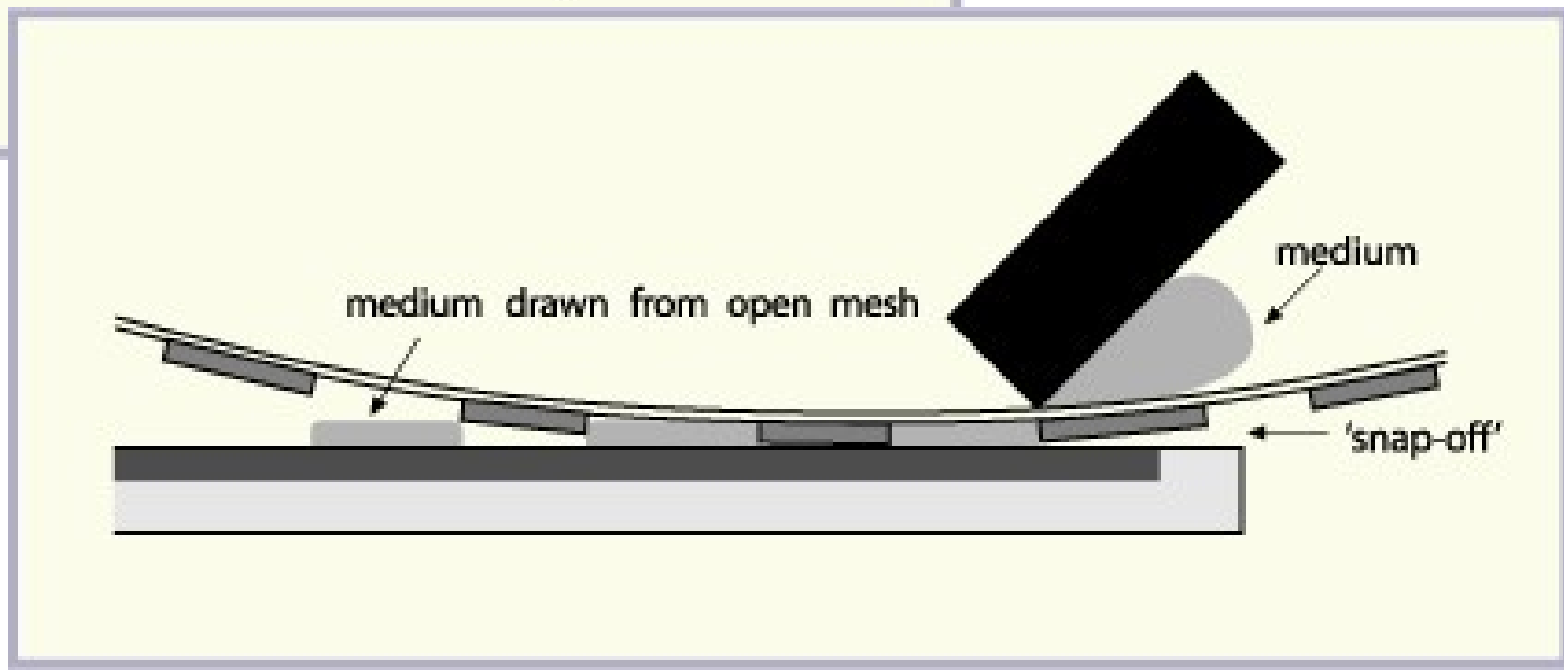
1. Simple and cost effective.
2. Stencils can be made rapidly and can be used for small orders.
3. Color combination is good in it.

- **DISADVANTAGES**

1. Good design is difficult to obtain.
2. Process is laborious.
3. Not suitable for large scale production.

Screen printing





screen-printing history

- The screen-printing process is a recognized and accepted method of printing, and can be easily and quickly mastered. This principle of printing dates back to ancient times when the Chinese, Egyptians and Japanese pounded colored pigments through stencils woven from human hair onto a variety of objects.

Flat screen-printing

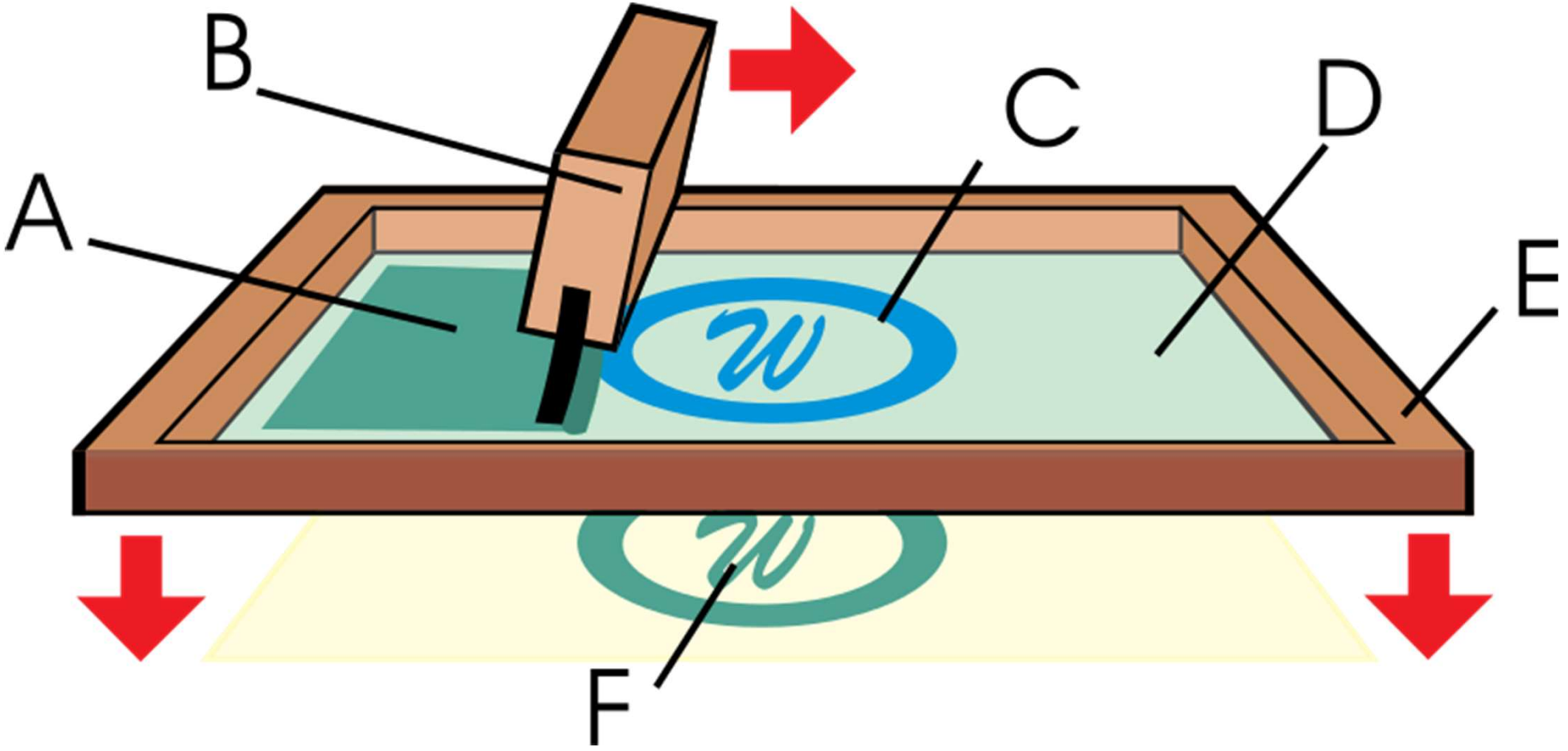
In flat screen printing, a screen on which print paste has been applied is lowered onto a section of fabric.

A squeegee then moves across the screen, forcing the print paste through the screen and into the fabric. The screen is the image carrier made from a porous mesh stretched tightly over a metal frame.

A positive stencil using negative art work is produced on the mesh either manually or photo chemically. Ink is then forced through the fine mesh openings using a squeegee that is drawn across the screen allowing print paste to pass through only the areas where no stencil is applied.

Flat screen-printing

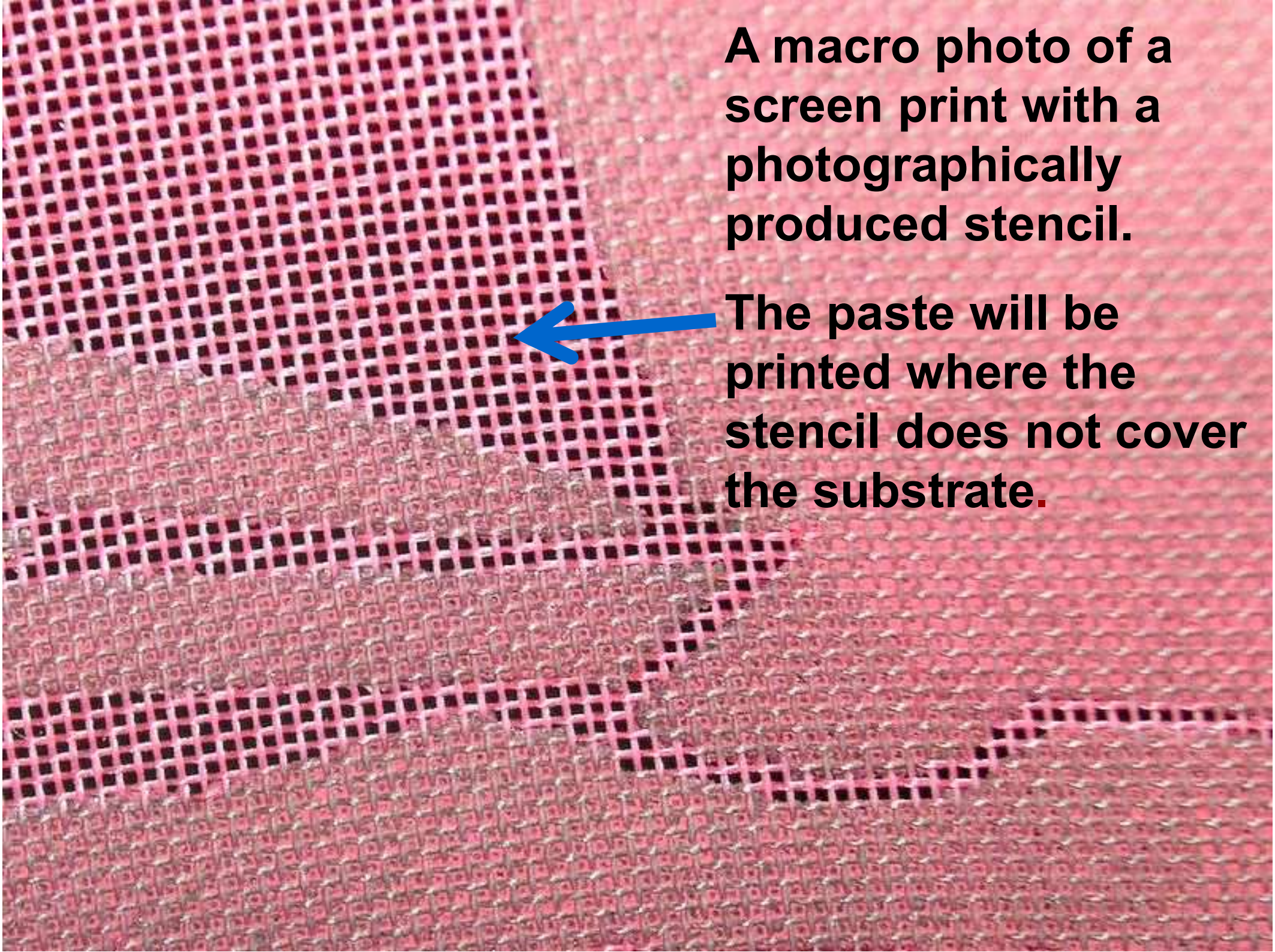
A. Ink. B. Squeegee. C. Image. D. Photo-emulsion on screen. E. Stencil. F. Printed image.

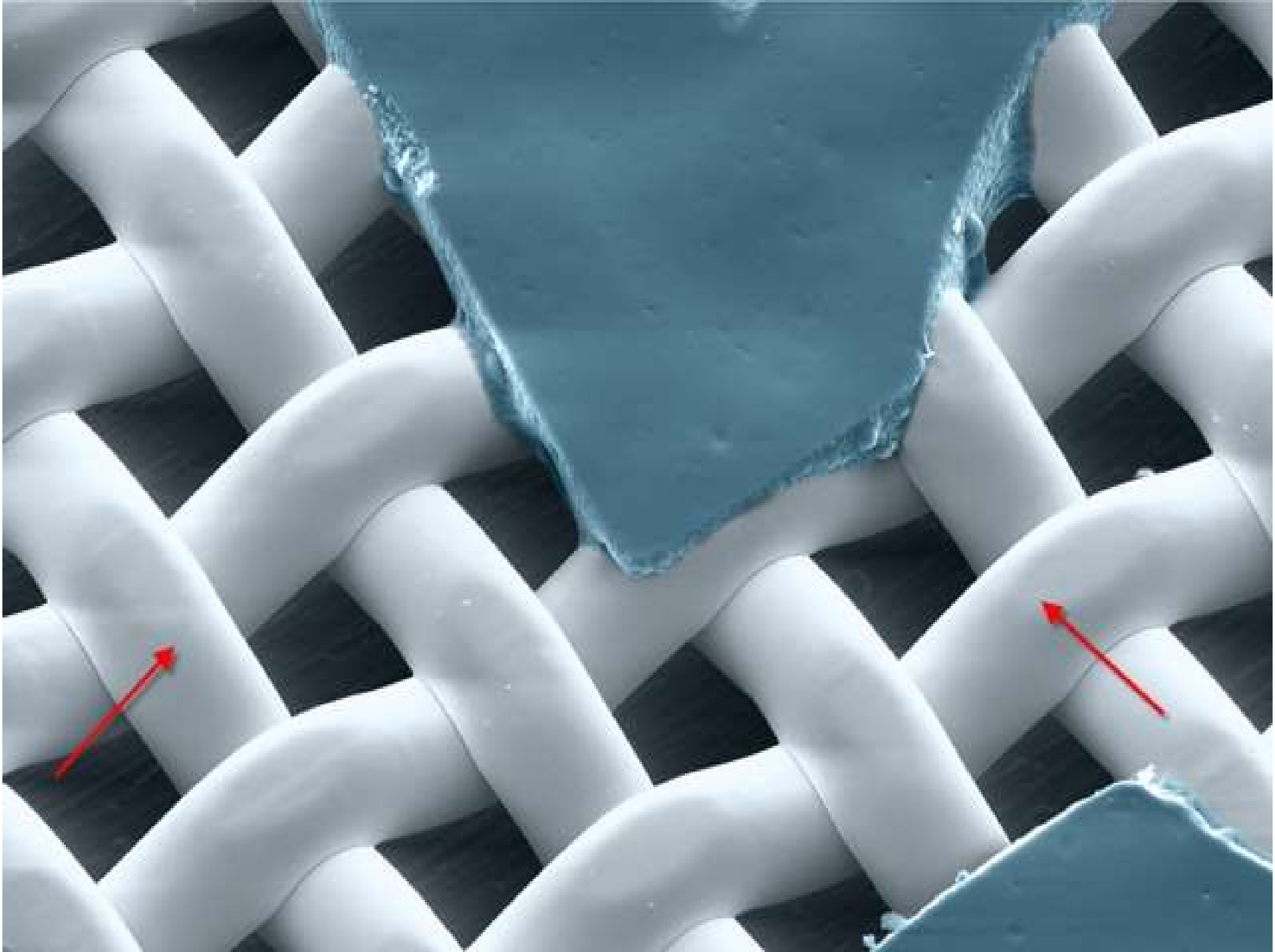


Flat screen-printing

Tools and Materials

- **Frame** - Made from wood or metal. Has grooves
- **Screen** - Fabric made up of fine, evenly spaced strands
- **Adhering Solution** - Solution used to “stick” film to the screen
- **Squeegee** - Instrument used to “push” ink through screen
- **Alignment tab** - Keeps paper in the same place


A macro photo of a screen print with a photographically produced stencil.
The paste will be printed where the stencil does not cover the substrate.



Types of screen Fabric

- Silk - most expensive
- Organdy - cheapest
- Polyester - middle of the road
- Nylon - used for non-flat substrates
- Metal Mesh - most durable, but expensive
- Metalized Polyester - durable but not too expensive

SCREEN PRINTING

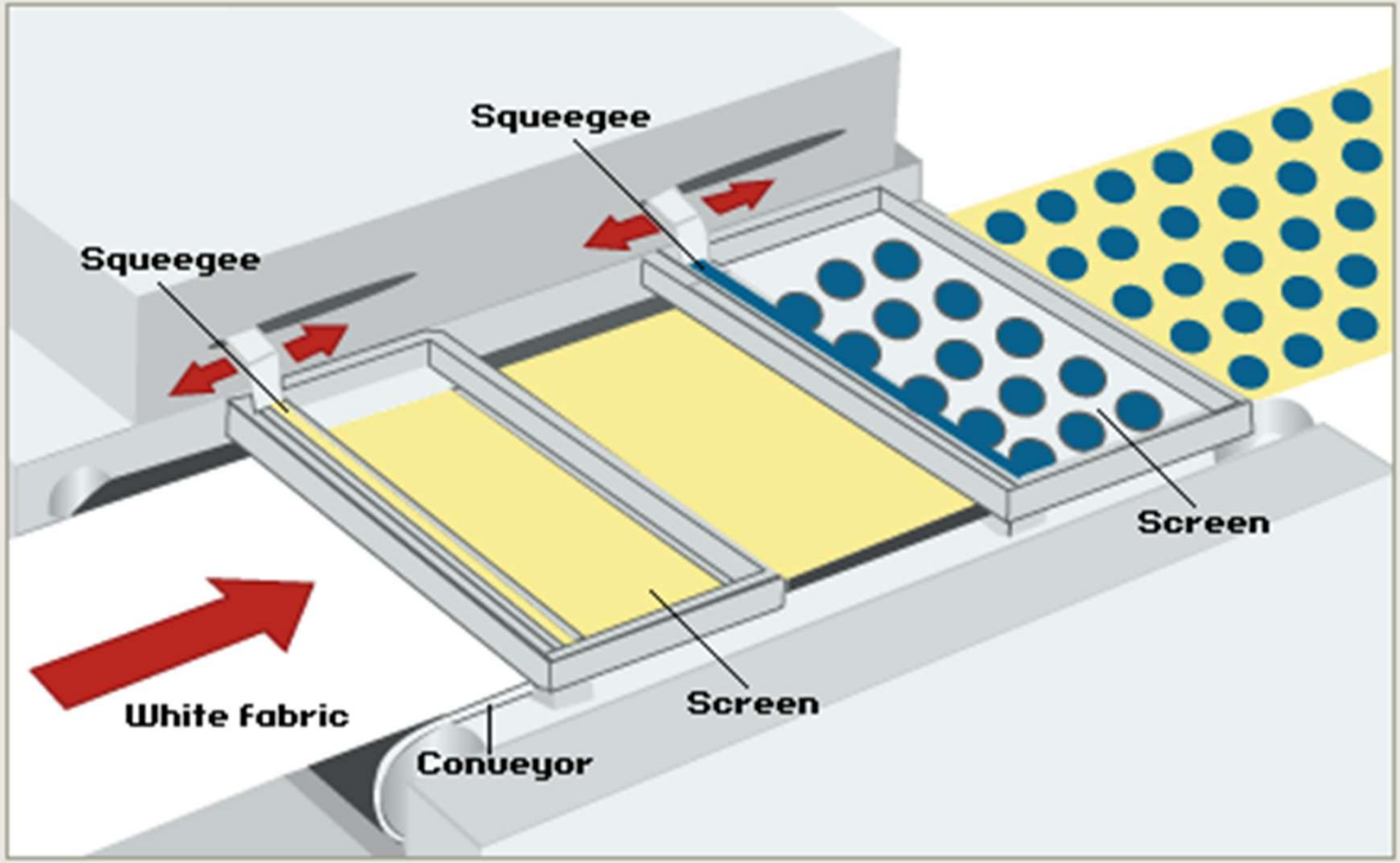
- **ADVANTAGES**

1. Simple and cost effective.
2. Quick pattern making
3. 16 colors can be used in a design.
4. Sharp lines and features easily produced.

- **DISADVANTAGES**

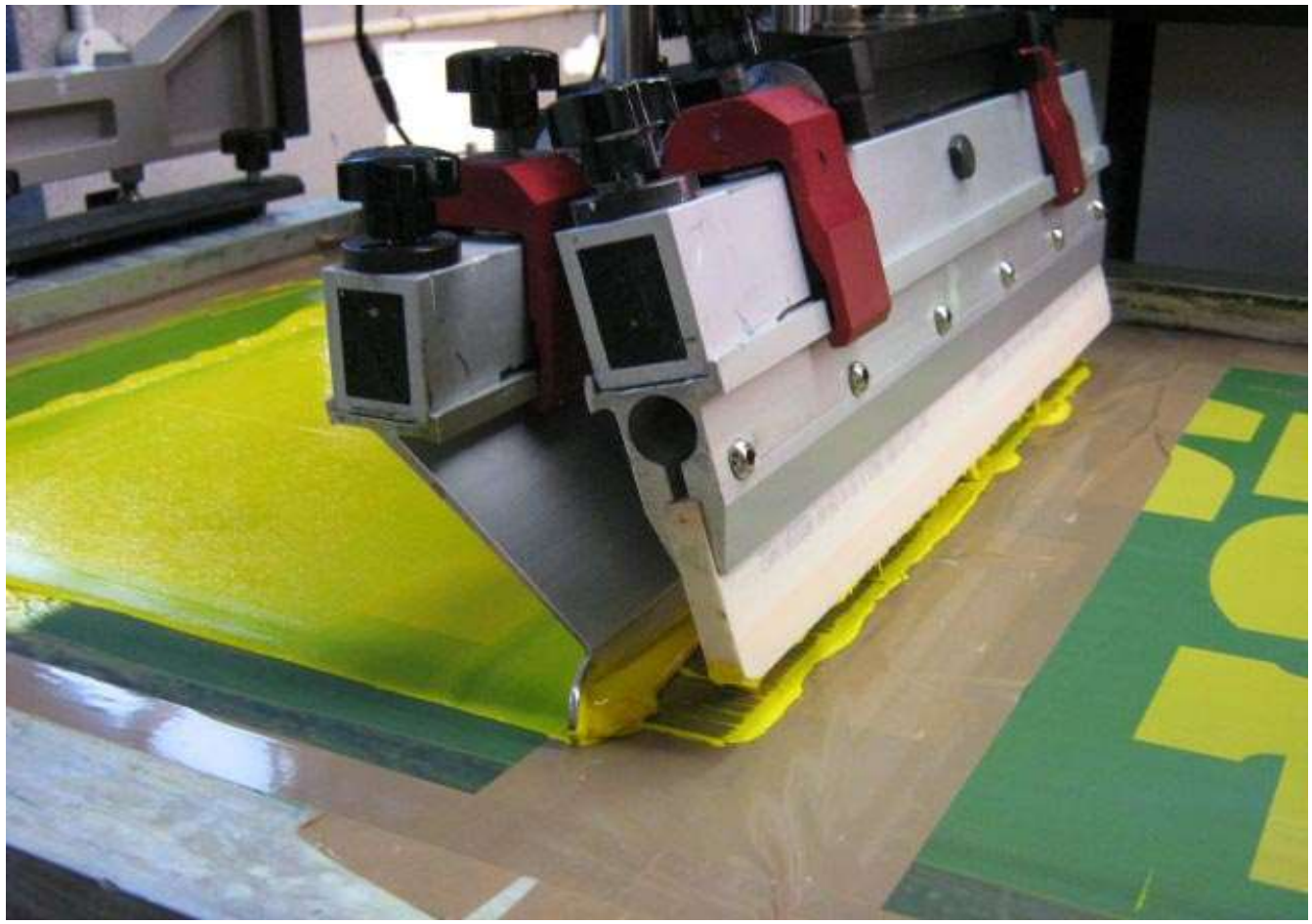
1. For high production large no. of tables required.
2. Delicate shading difficult to obtain.
3. Screen clogging may be there in fine areas.

Industrial flad-bed screen printing



SCREEN PRINTING

raportním zařízením – umožňuje plynulou návaznost jednotlivych tisků na sebe a při několikabarevném tisku též umožňuje správné umístění jednotlivych barev podle návrhu.



Carousel Screen Printing Process

The use of a carousel allows production to be quicker and more efficient. This process list assumes that the machinery is set up and the screens are inked.

Inked screen with stencil is lowered onto paper.

The ink is transferred.

Inked screen is lifted up and rotated to a screen with a different colour and shape .

This is repeated until all colours and shapes have been printed.

Print → Rotate → Print → Final Product/ Print finished

SCREEN PRINTING

- It involves the application of the printing paste through a fine screen placed in contact with the fabric to be printed.
- A design is created in reverse on the screen by blocking areas of the screen with a material such as an opaque paint.
- The screen is then placed over the fabric and the printing paste is forced through the open areas of the screen using a flexible synthetic rubber or steel blade known as a squeegee.

PROCESS OF SCREEN PRINTING

SCREEN PAPER SIDE

SCREEN SQUEEZE SIDE

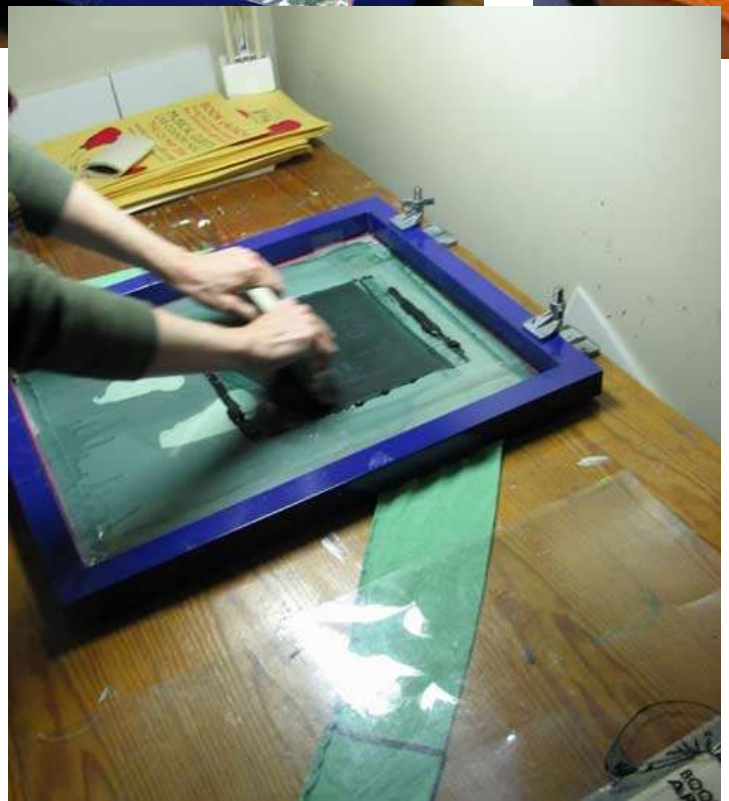
ORIGINAL PRINT

PRINT ON FABRIC


Diazo Photo Emulsion
Diazo


BOOK ART


BOOK
ART




BOOK
ART

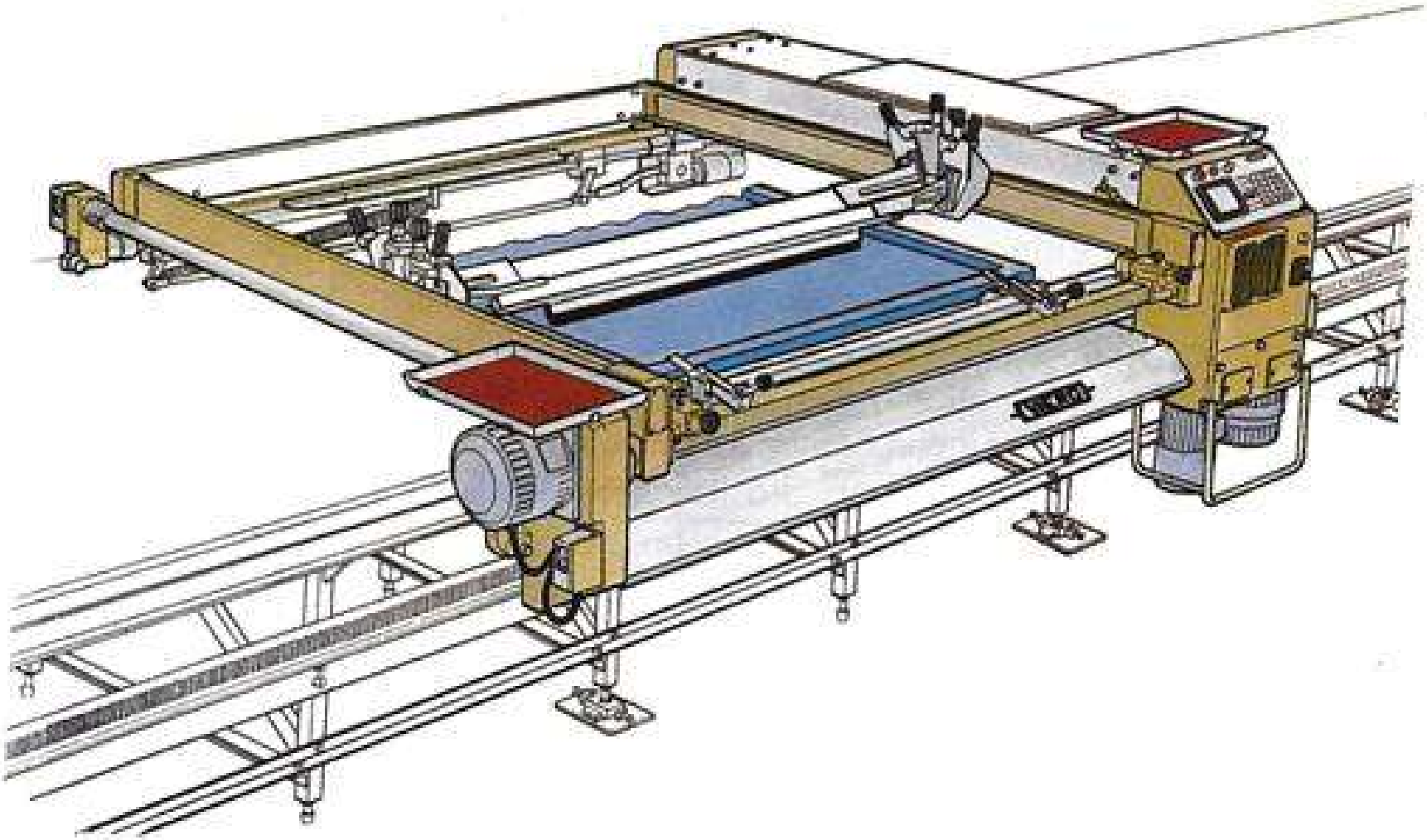
FLAT-SCREEN PRINTING

- It is the advanced version of screen printing by using automatic m/c to do work
- It consists of printing table, conveyor belt, number of screens, mechanism to print on the fabric, etc.
- First the fabric is brought on the printing table through a feeding arrangement and it is gummed to the conveyor belt on the table

FLAT-SCREEN PRINTING

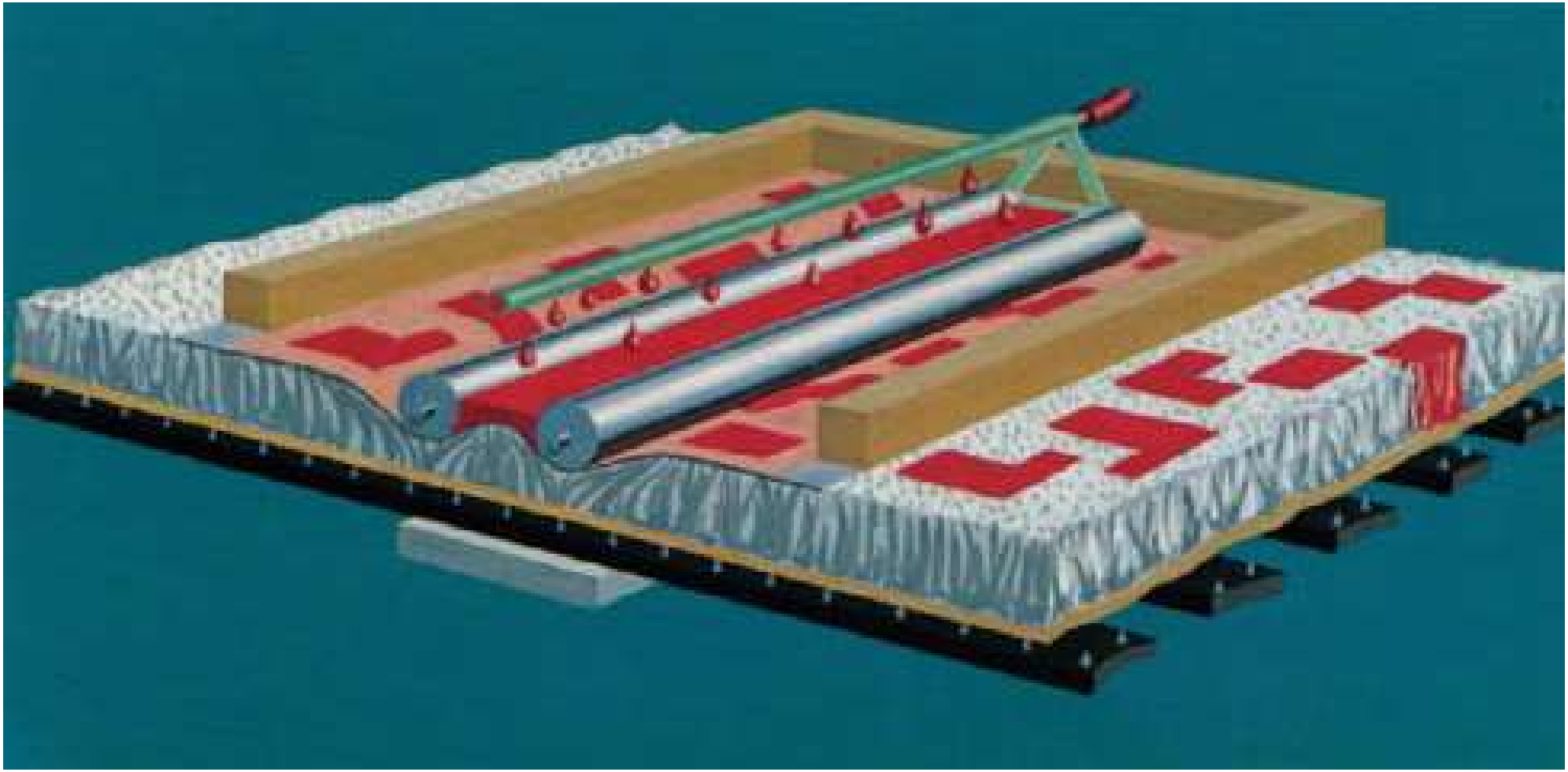
- Conveyor brings fabric periodically under screen and stops while the screen are lowered on the required parts of the fabric.
- Printing paste is distributed throughout the full length of the screen.
- The squeeze is pressed to the screen .
- One or more strokes of the squeeze ensure simultaneous printing of the pattern by the common action of all screens which applies printing paste as required by the color in the design.

FLAT-SCREEN PRINTING



SCREEN PRINTING

Printing of Carpets



FLAT SCREEN PRINTING

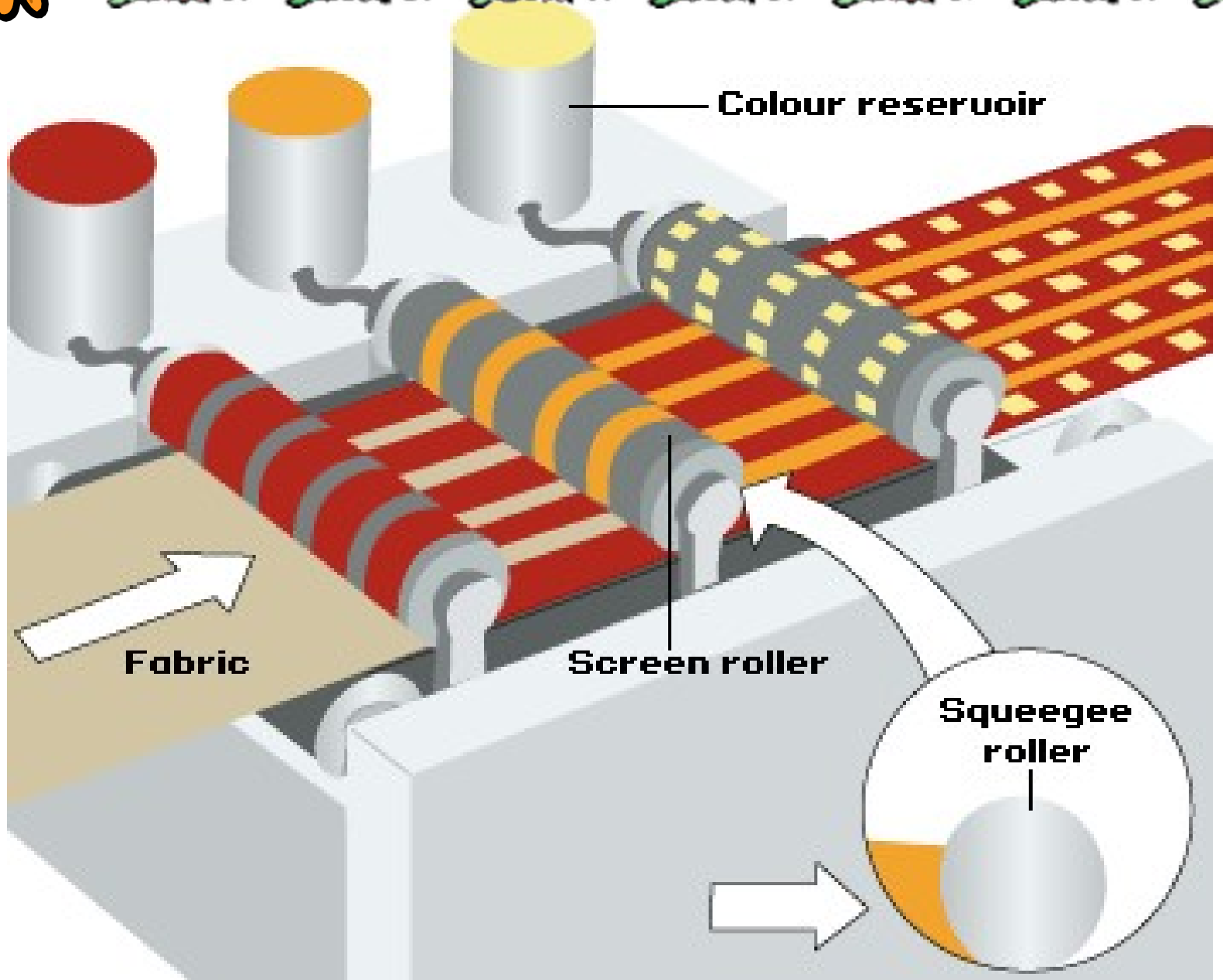
- ADVANTAGES

1. Greater production than manual screen printing
2. Printing with different repeat can be made easily
3. Good print is obtained

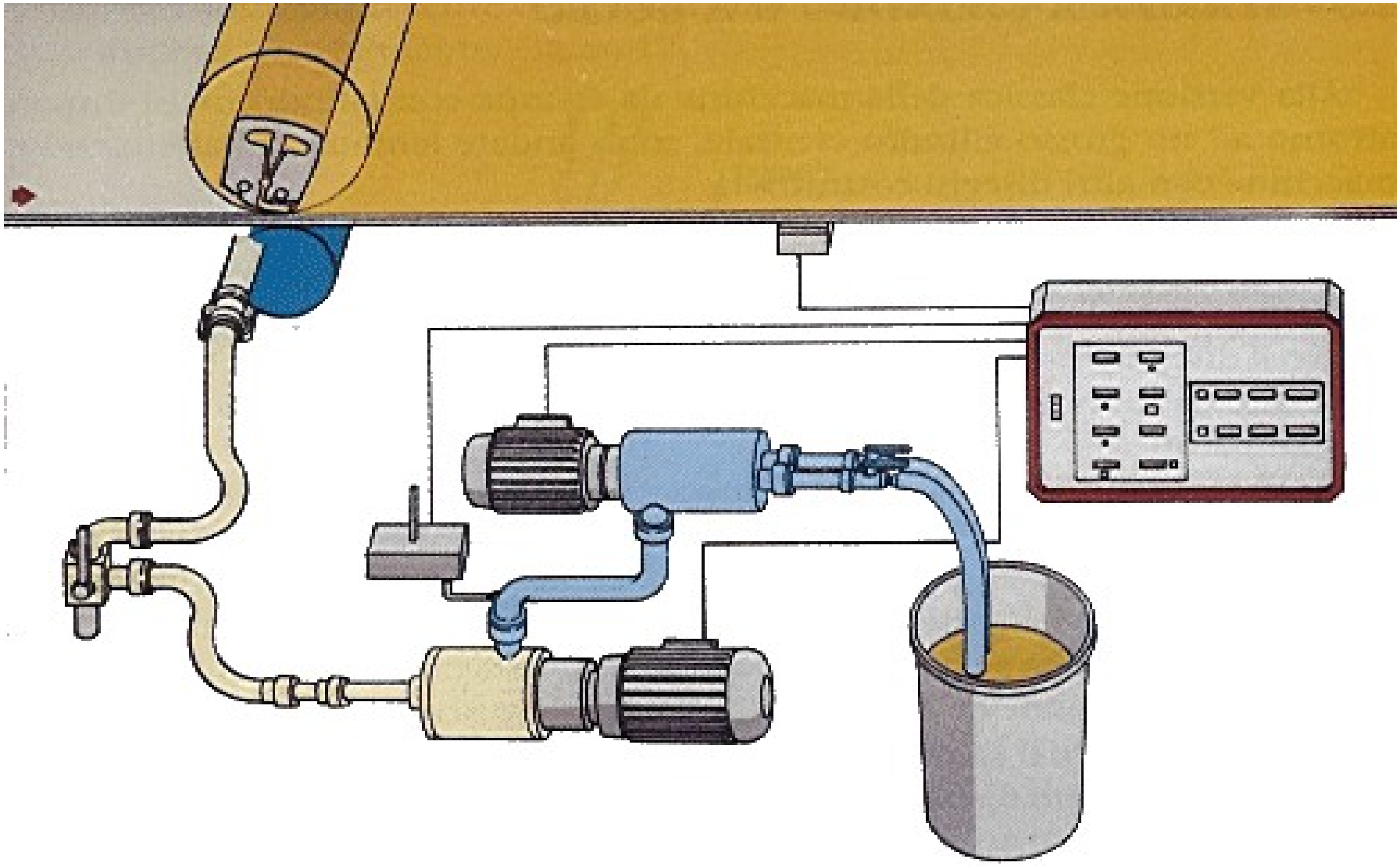
- DISADVANTAGES

1. A big setup required for more number of screens
2. Prints with more colors may not be possible
3. Printing paste not evenly controlled

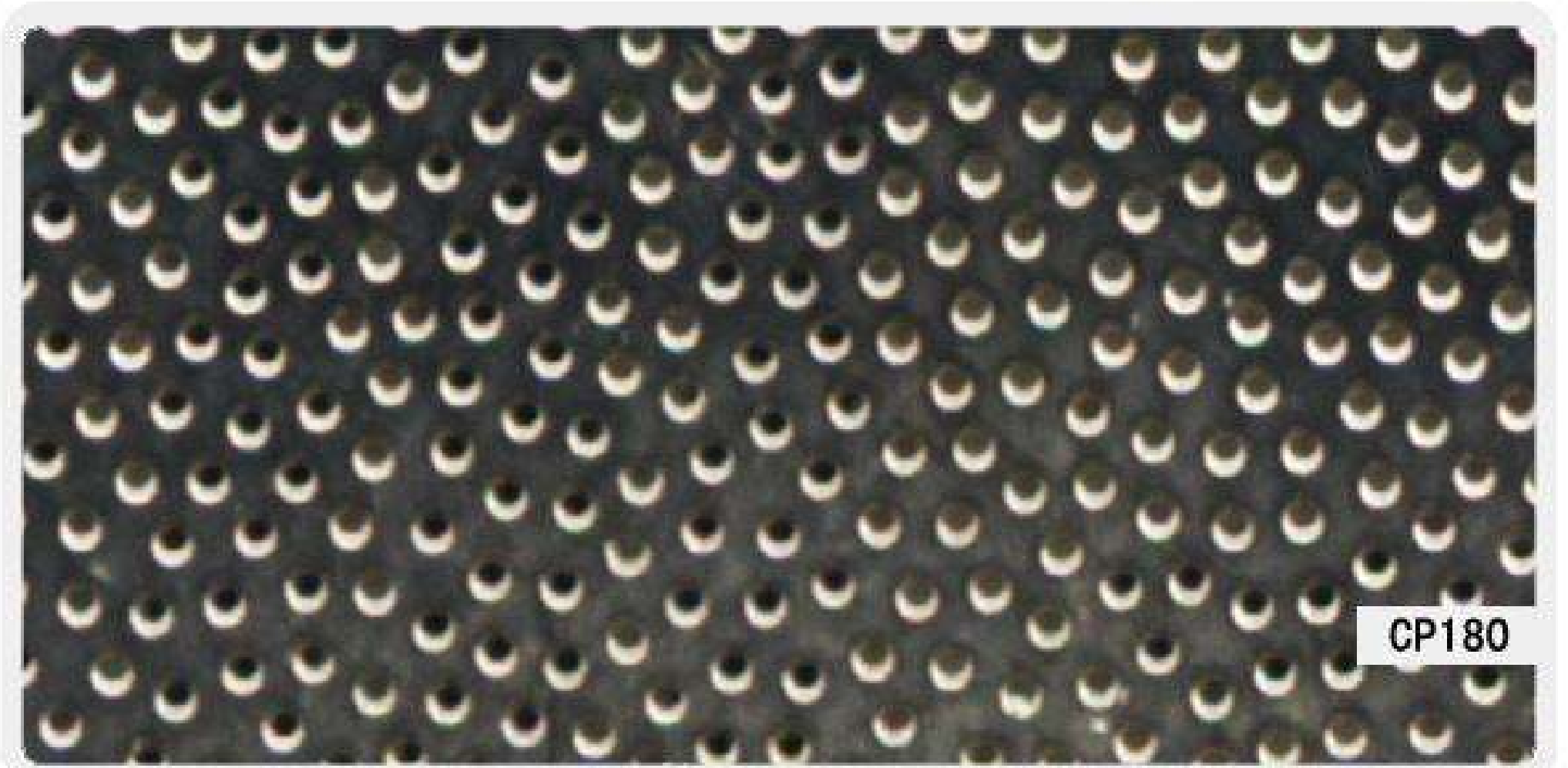
Working of rotary screen printing



Feeding of color to rollers

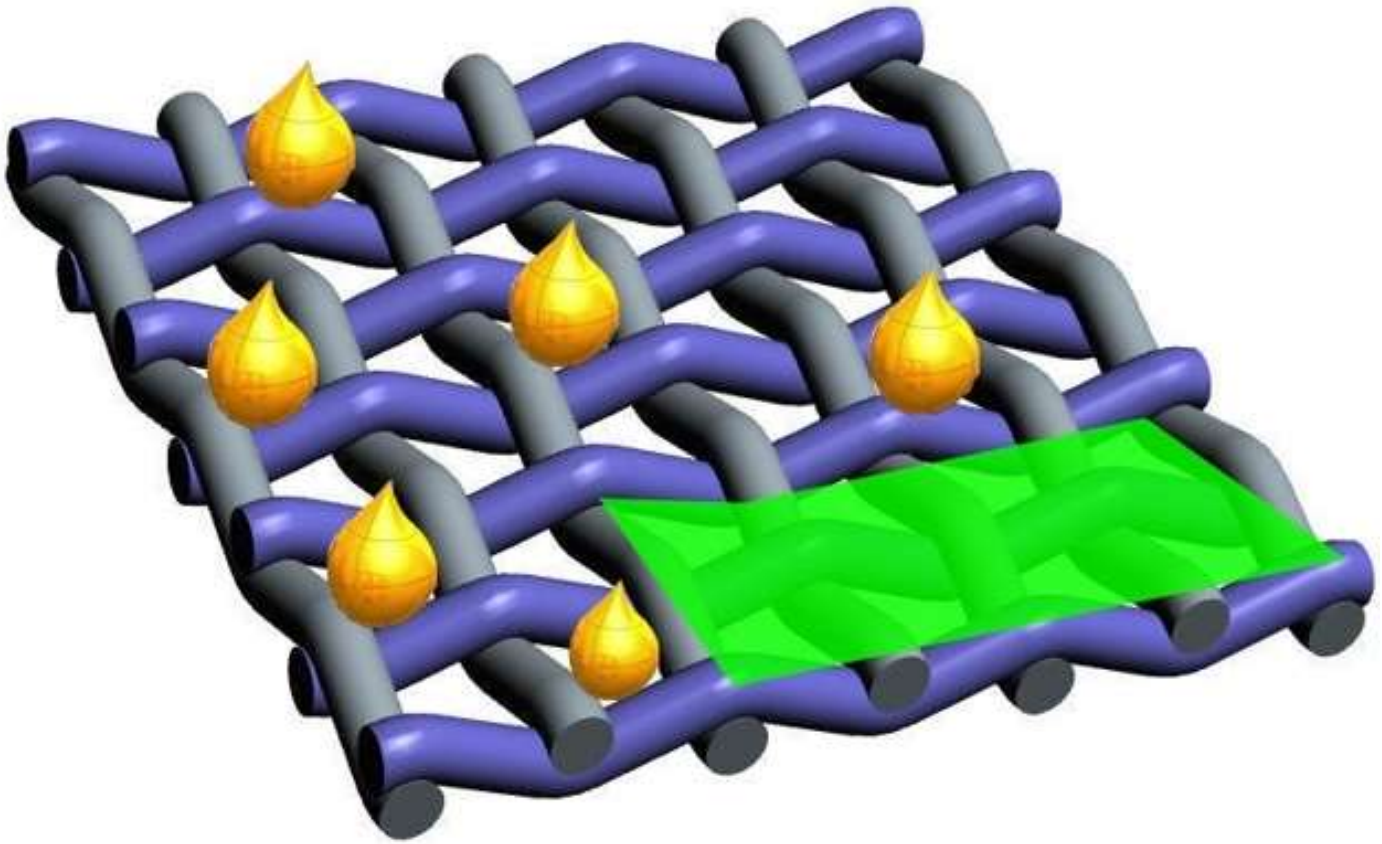


Rotary SCREEN PRINTING



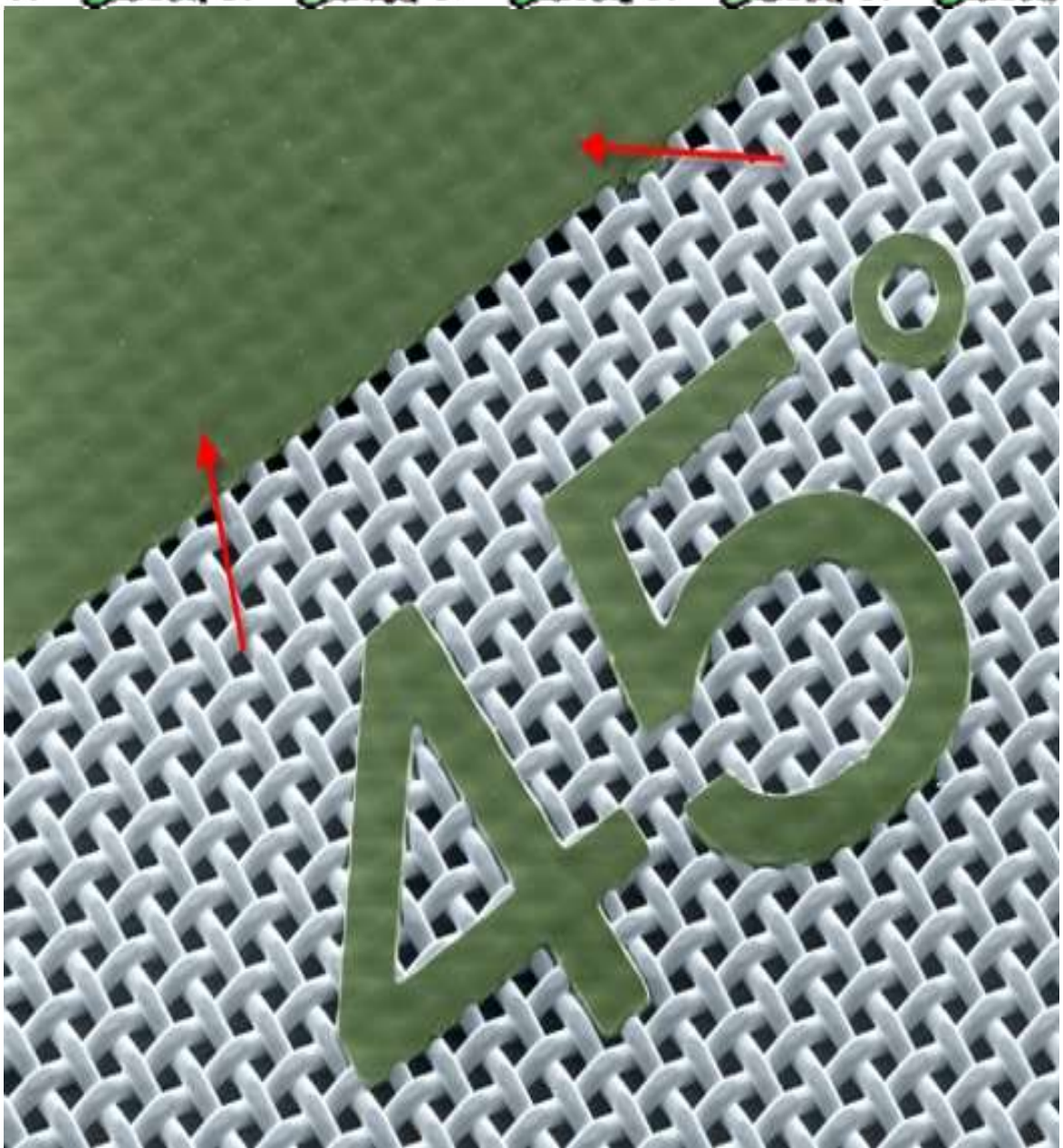
Rotary SCREEN PRINTING

- The green polymer layer controls the targeted ink flow of the yellow ink droplets.



Rotary SCREEN PRINTING

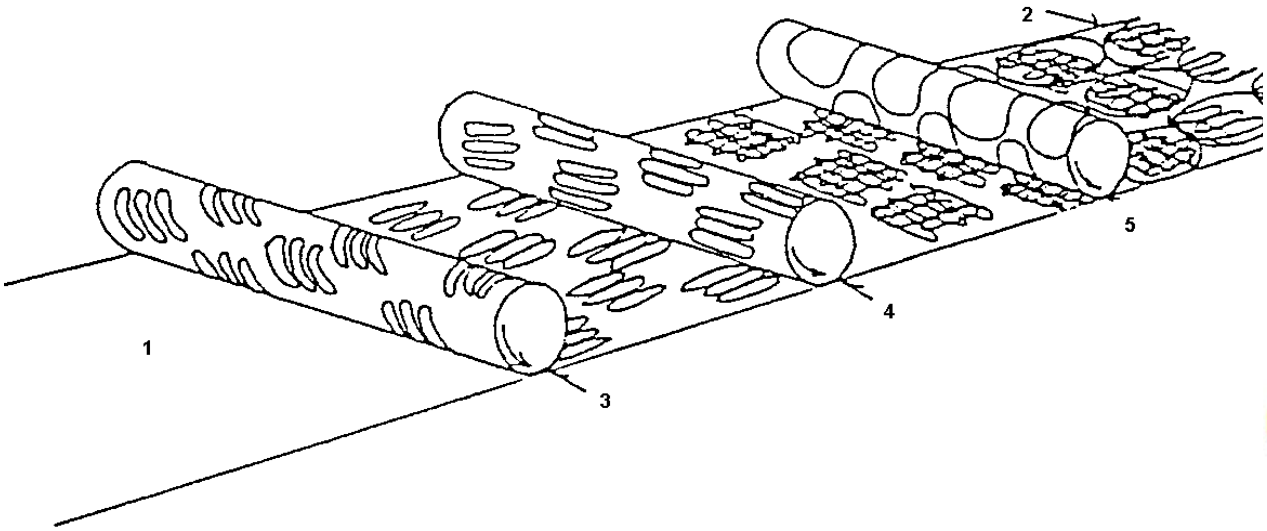
full-area photopolymer layer is applied to the steel fabric in the cleanroom. It is important to ensure that there are no gaps in this layer and that its thickness remains the same over the entire screen fabric (EOM = emulsion over mesh). If these basic requirements are not met, it is not possible to define and specifically control ink transfer.

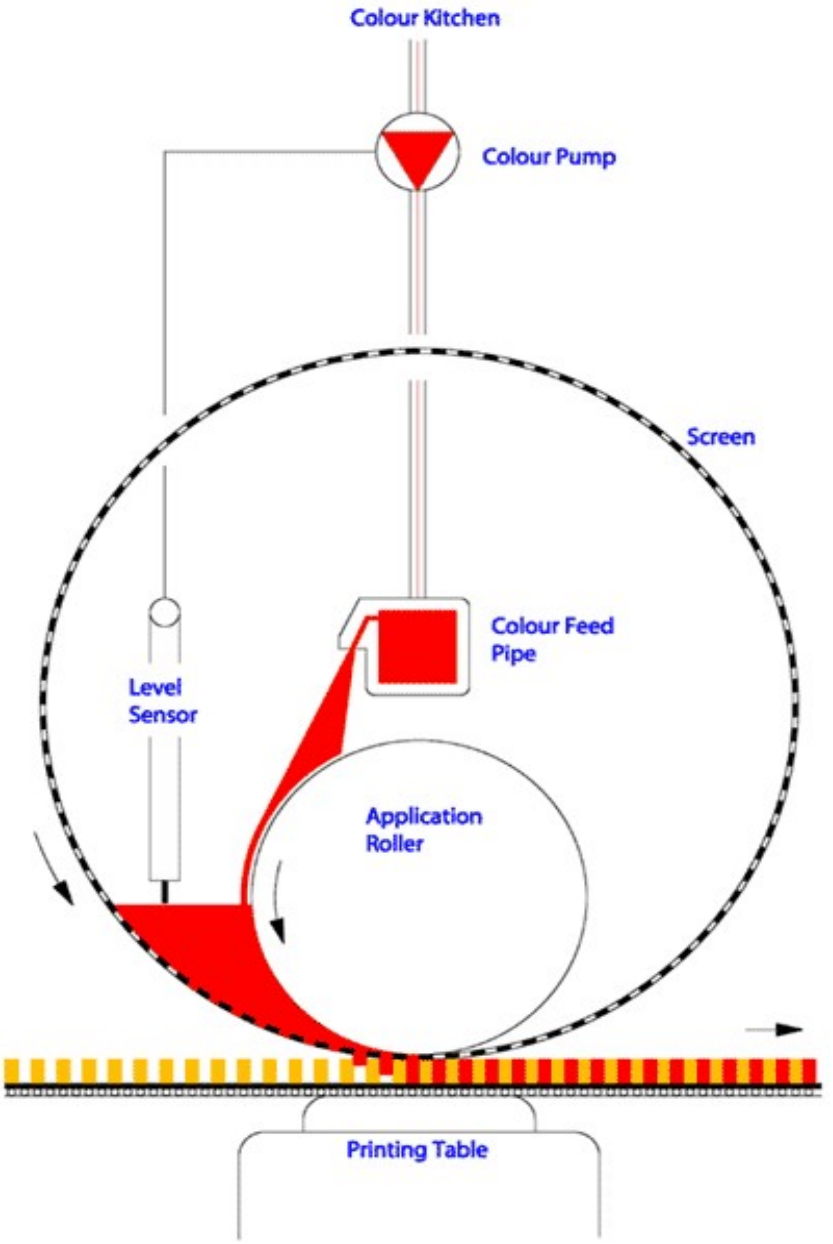


SCREEN PRINTING

Printing rate 25–50 m/min

Flat screenp rinting up to 10 m/min





SCREEN PRINTING

Rotary SCREEN PRINTING

- Rotary screen printing involves a series of revolving metal cylinder , each with revolving screens, each with a stationary squeegee inside which forces the print paste onto the fabric.
- Twenty or more colours can be printed at the same time.
- The process is much quicker and more efficient than flat screen printing .

Rotary SCREEN PRINTING

Rotary screen printing is so named because it uses a cylindrical screen that rotates in a fixed position rather than a flat screen that is raised and lowered over the same print location. Rotary presses place the squeegee within the screen. These machines are designed for roll-to-roll printing on fabric ranging from narrow to wide-format textiles.

In rotary printing, the fabric travels at a consistent speed between the screen and a steel or rubber impression roller immediately below the screen. (The impression roller serves the same function as the press bed on a flatbed press.) As the fabric passes through the rotary unit, the screen spins at a rate that identically matches the speed of substrate movement.

Rotary SCREEN PRINTING

- The squeegee on a rotary press is in a fixed position with its edge making contact with the inside surface of the screen precisely at the point where the screen, substrate, and impression roller come together . Ink is automatically fed into the center of the screen and collects in a wedge-shaped “well” formed by the leading side of the squeegee and the screen’s interior surface. The motion of the screen causes this bead of ink to roll, which forces ink into stencil openings, essentially flooding the screen without requiring a floodbar. The squeegee then shears the ink as the stencil and substrate come into contact, allowing the ink to transfer cleanly to the material.

Rotary SCREEN PRINTING

- By converting the screen-printing process from semi-continuous to continuous, higher production speeds are obtained than in flat bed printing - speeds are from 50-120 yards per minute.
- Rotary screen machines are more compact than flat screen machines.
- Also with rotary screens, the size of the design repeat is dependent upon the circumference of the screens. This was initially seen as a disadvantage, because the first rotary screens were small in diameter. However, with today's equipment, screens are available in a range of sizes and are no longer considered design limited.

Rotary SCREEN PRINTING

- Estimates indicate that this technique controls approximately 65% of the printed fabric market worldwide. The principle disadvantage of rotary screen printing is the high fixed cost of the equipment. The machines are generally not profitable for short yardages of widely varying patterns, because of the clean-up and machine down time when changing patterns. Flat screen printing is much more suitable for high pile fabrics, because only one squeegee pass is available with rotary screen. However, rotary machines are used for carpet and other types of pile fabrics. Most knit fabric is printed by the rotary screen method, because it does not stress (pull or stretch) the fabric during the process.

TRANSFER PRINTING

This is essentially transferring an image to fabric from a paper carrier. When heat and pressure are applied to this paper the inks are transferred. Some transfers are topical, and the image sits on the surface of the fabric. Other transfers are absorbed into the fibres of the fabric.

Heat transfer printing is clean and environmentally safe. The only by-product is the paper carrier. It is the perfect print method for short run and sample production, but can also be used for batch production as well.

TRANSFER PRINTING

Dye sublimation allows photo lab quality picture printing. During the dye sublimation printing process, an image is digitally printed in reverse with dye sublimation toners or inks onto media. That image is then placed on top of a fabric and subjected to high heat and pressure to form a heat press. The dye sublimation toners or inks sublimate – the inks go from a solid state to a gaseous state without becoming liquid in between and flow into the fabric, dyeing the threads.

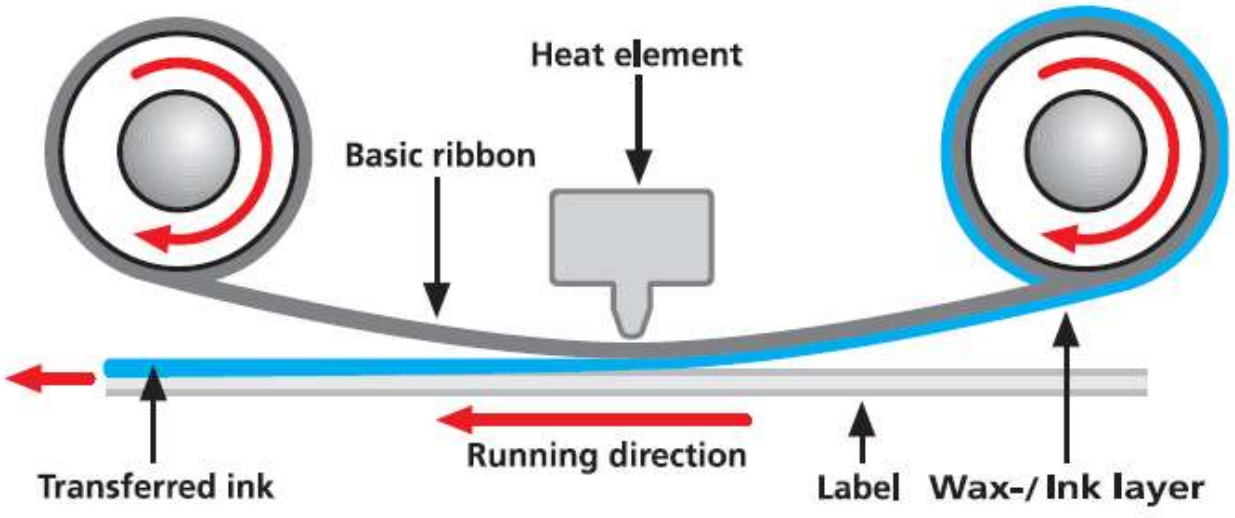
This creates a gentle gradation of colour and does not distort or fade over time.

TRANSFER PRINTING

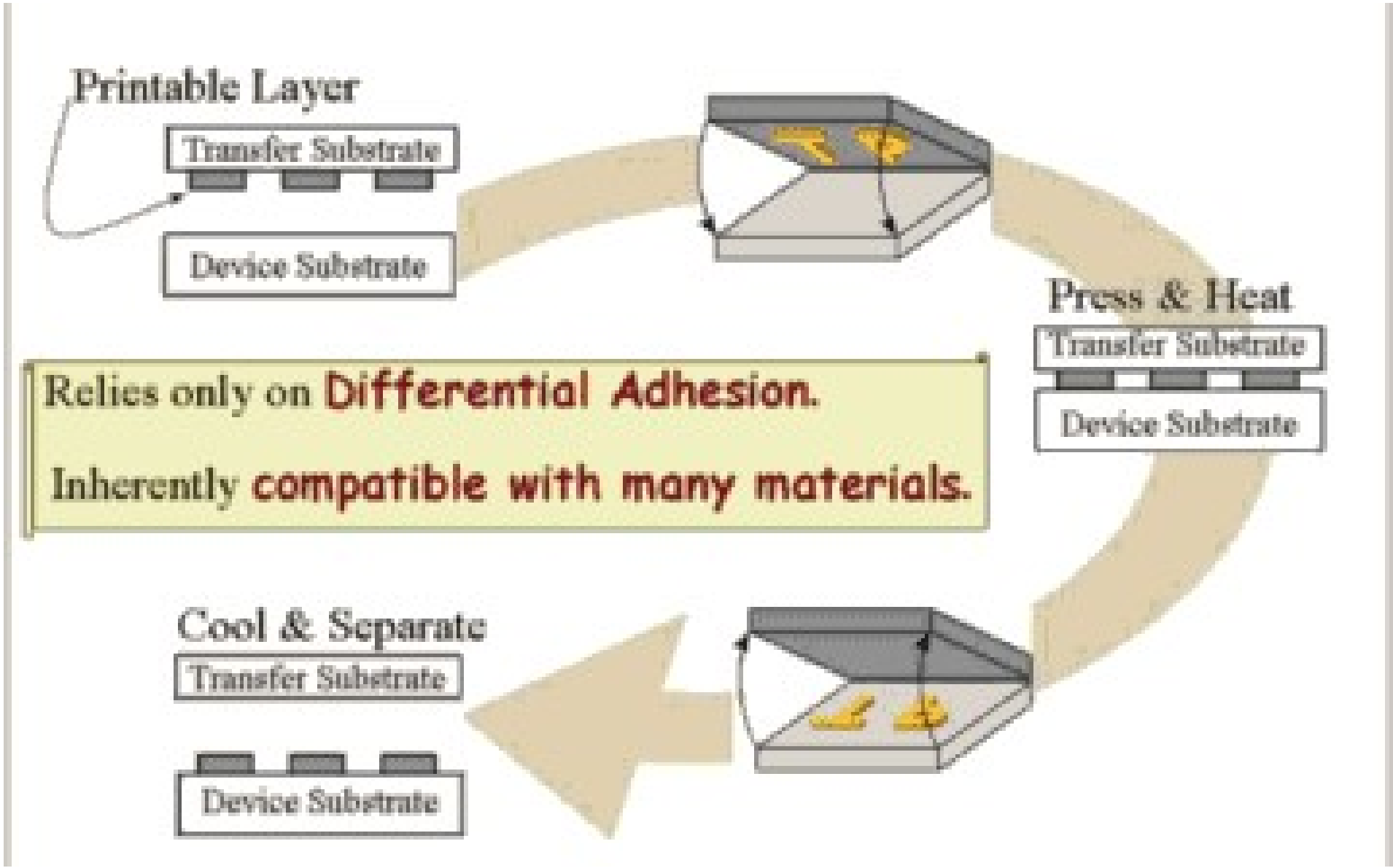
- It is a indirect method of printing in which dyes are transferred from paper to a thermoplastic fabric under controlled conditions of temperature, time and pressure.
- The image is first engraved on a copper plate.
- Then pigment is applied on these plates.
- The image is then transferred to a piece of paper, with a layer of glue applied .
- This is then placed on the fabric and heat and pressure applied which fixes the print onto fabric.

TRANSFER PRINTING

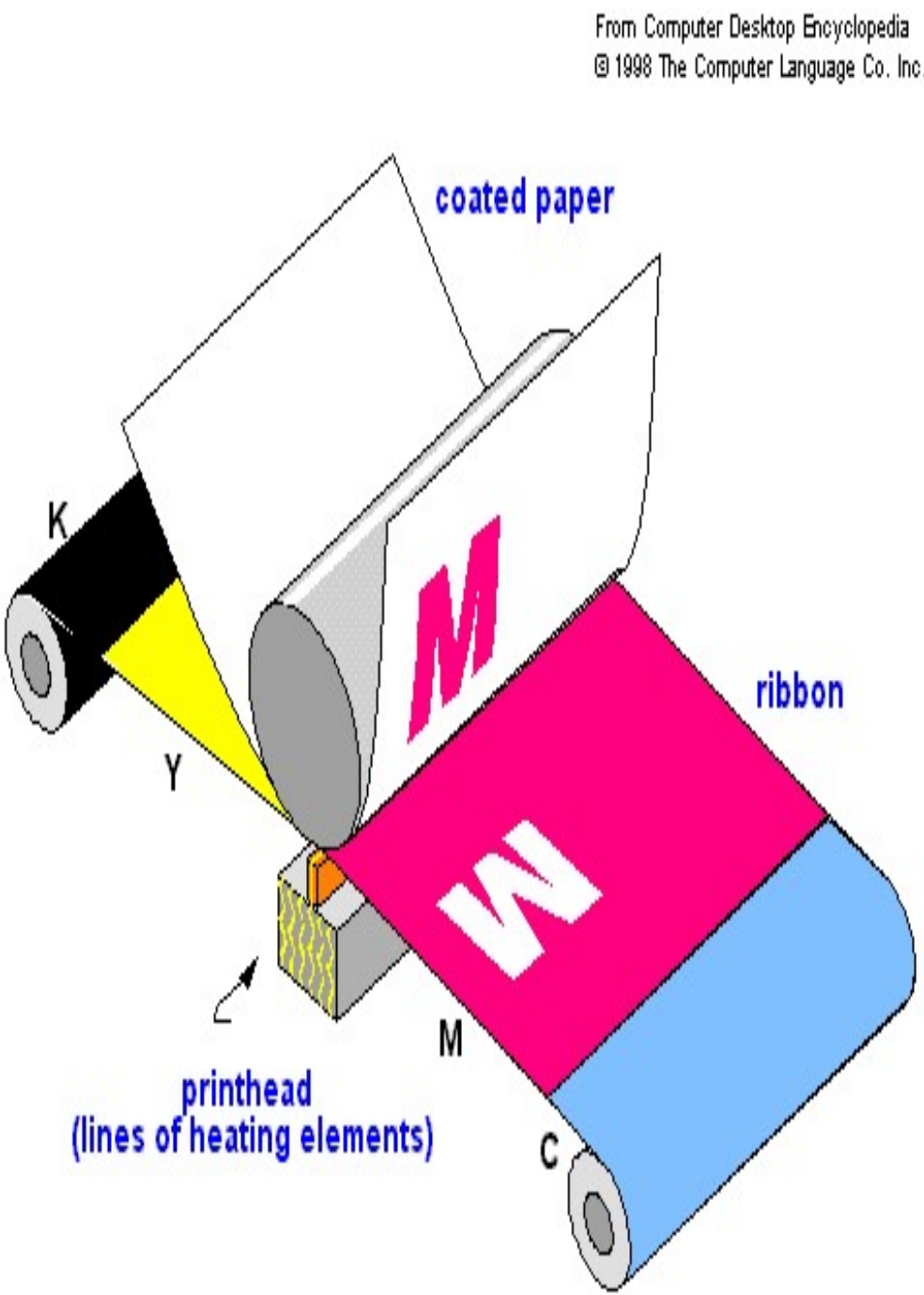
Thermal transfer printing is a digital printing process in which material is applied to paper (or some other material) by melting a coating of ribbon so that it stays glued to the material on which the print is applied. It contrasts with direct thermal printingwhere no ribbon is present in the process. It was invented by SATO corporation. The world's first thermal transfer label printer SATO M-2311 was produced in 1981.

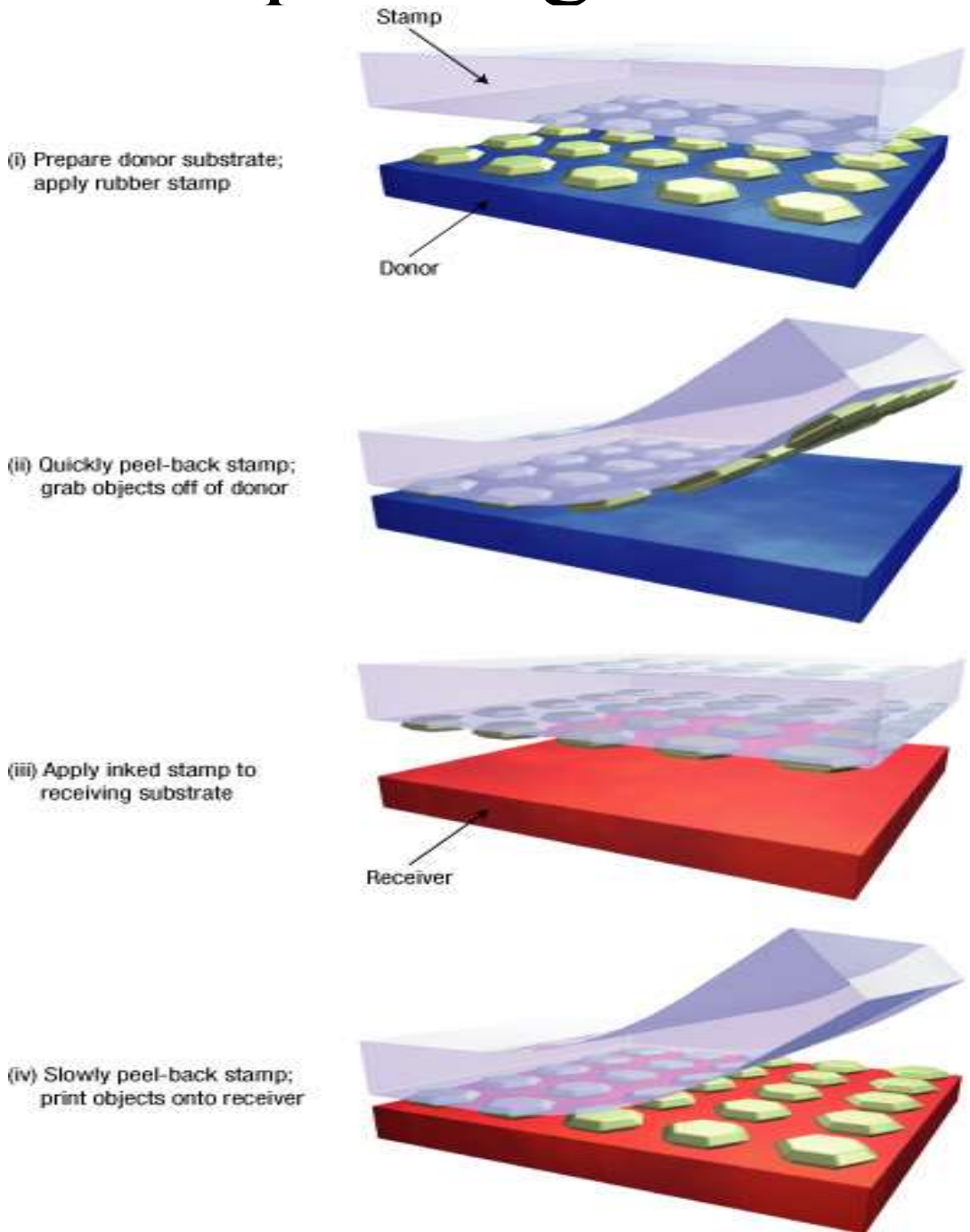


TRANSFER PRINTING



Process of transfer printing





TRANSFER PRINTING

- ADVANTAGES

1. Operation is simple and no expensive m/c is required.
2. No after treatment of fabric required
3. Print on fabric is of excellent quality

- DISADVANTAGES

1. Process applicable to synthetic fabric like polyester .
2. Color range is limited.
3. Cost of printed paper high.
4. Not economical for small orders.

Thanks for attention!