Ch—1 Automatic Flat-bed screen printing

1.1 --Buser Automatic screen printing machine:

1.1.a) Principle- it consists of a strong steel frame with a printing table. At entrance of m/c there is a glueing unit. An endless printing blanket runs over and under the table, the fabric to be printed is glued to this belt. There are magnets that grasp the printing belt at both sides and over its full length at feed step. These are necessary to avoid displacement of design.

Each screen is placed in a holding device having its own squeezee mechanism (with its independent motor). The number of strokes by squeezee and pressure applied by squeegee may vary. Squeezeeing is done in weft direction of fabric .

Lifting squeegee units with screens is done in to different way. Either both ends of screen can be lifted or screen can be lifted from one end of print.

Under the table are washing facilities for endless printing belt.

1.1.b) Squeegee operation – it is as follows.

I Advance of printing belt to which the fabric is glued the screen are lowered halfway.

II The printing belt stops; the screens are lowered; the clamps along the edges of printing belt shut.

III The screens are squeegeed with number of strokes for each screen. While this printing is being effected, the belt moving magnets return to starting position.

IV The screen are lifted; the feeding magnets close and clamping plates release the printing belt and cycle repeats with start of stage 1.

At end of m/c there is a dryer, the printed fabric enters the dryer in a spiral form and is discharged from side.

No. of screens that can be used depends on size of m/c and dimension of screen. Example-

15 colours, of repeat size 700mm.
11 colours of repeat size 850mm
9 colours of repeat size 1100mm.

Cloth width can be 1120-2490mm. The squeegee mechanism consists of a double squeegee. White printing, front squeegee is lifted and rear one pushes colours paste over screen. When other end, the squeegees change their position.
A printer and a helper are needed to supervise the m/c.

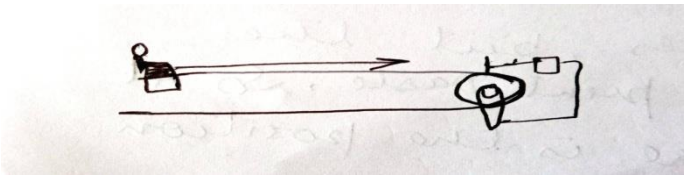
1..2-- Stork automatic screen printing m/c.

There is a steel frame with braces and a printing table is mounted on this. The endless printing belt runs over two main rollers. The entire printing operation is powered by a single motor.

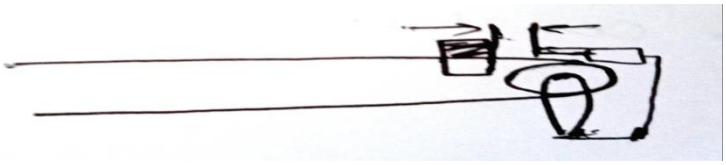
The screens are suspended into screen holders. Magnetic squeegee systems are used. Pressure applied by squeegee can be varied. Squeegeeing is done longitudinally over the fabric. The m/c is designed to give one squeegee stroke only. The squeegee carriage jointly moves all squeegee over line screens and at the end of stroke, it raises them all away from printing paste. For next repeat the squeegee motion is in opposite directions.

• **Repeat advance** – A micro device monitors the true to repeat advance of printing belt. As soon as correct repeat length is reached, the drive of printing belt is stopped. The process takes place in 4 steps.

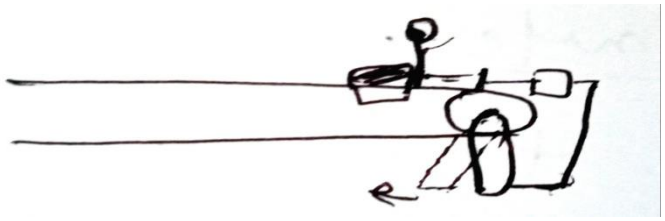
1. From an adjustable stop a gauging block is electromagnetically clamped to and carried along by the printing belt.



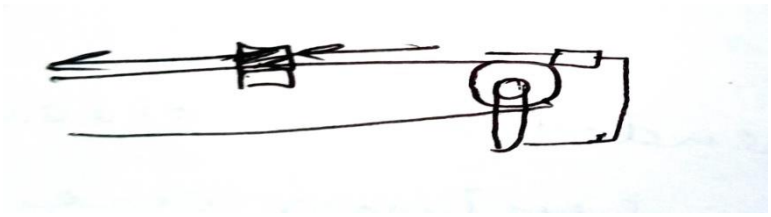
2. A hydraulic lever takes over drive shortly before the end mechanism advance motion.



3. The hydraulic drive moves the printing belt onward until the gauging block contacts a feeler that immediately stop hydraulic drive.



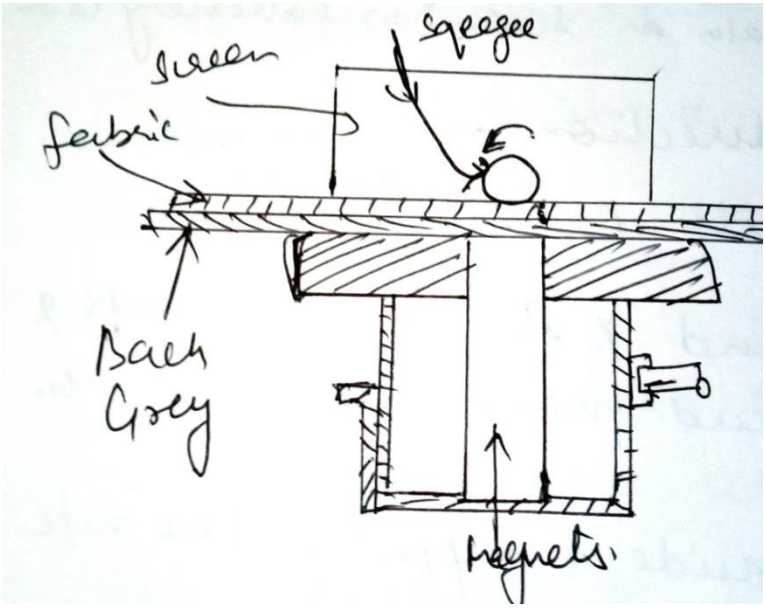
4. The gauging block returns to its starting position



***Squeegeeing principle** - For higher production, a single stroke of squeegee is used for all fabrics. For this, a squeegee of soft flexible knife edge is selected and printing is done on a hard table. Pressure applied by squeegee on screen can be regulated. If squeegee is pressed heavily, then rubber knife edge of squeegee bends and a wedge shape space is formed.

The wedge shape squeegee form an angle between rubber and fabric to be printed, it generates a liquid pressure. It increases as speed of squeegee increases, but on the other hand the fabric has less time to absorb print paste. So at that time controlling feature is the position of squeegee and not speed of squeegee.

1.3--Zimmer Automatic screen printing m/c --



There is no continuous printing table top (as in other m/c). At both ends of a steel frame, there are guide rollers installed for endless printing belt, there is a glueing mechanism for the fabric and a washing arrangement for printing belt. At the end of m/c, a drying chamber is provided for drying the printed fabric. Above printing belt, there are screen holders and colour trough for each screen.

The Squeegeeing arrangement is situated below the printing belt. The squeegee proper consists of a iron rod (3-20mm dia) which is placed loosely on screen and roll along it, guided by a magnet underneath the belt. It can be moved hydro mechanically length wise along the fabric. The pressure on iron rod can be regulated .

A colour trough equipied with drip mechanism across the width of screens, ensures a constant rate of paste feed equal to that at which it is transfered to the fabric. The squeegee roll dips into paste in screen and always carries same amount of paste ensures uniform printing. The screens can be lifted either from one end or horizontally parallel to the fabric.

Machine is built for 6,8,10 or 12 colours ,max. printing width is 1800mm. 2 workes are needed to run m/c- 1 printer and 1 helper

Printing speed is 4-20 sec/screen (6-15 repeats/min)

1.3.a) Advantage of magnetic squeegee over rubber squeegee –

I . As rod rolls instead of rubbing over screen, the mechanical strain on screen is externally low.

II Squeegee moves in direction of warp across width of fabric. It exerts constant uniform pressure.

III Squeegee does not bend and form wedge shape and there is no any liquid pressure generates up.

IV . As squeegee has no guide or support, the m/c is of low built design.

V Squeegee roll is lifted along with screen, it helps in design to be change frequently.

Fabric Detaching and drying- The detaching of printed fabric from blanket is done at the end of printing table without damaging the print. This is done by drying chamber. An endless blanket receives the printed fabric, lifts it upto upper part of chamber, where it passes through hot air jets. Delivery of fabric is done in plait form.

1.4 **Advantage of flat bed Machine:-**

1. Heavy blotches, big motifs and intricate designs are possible in this m/c.
2. Large no. of colours (10-12) can be used.
3. Freshness and bloom of colours is very good as colour remain on surface of fabric.
4. Less dye consumption than in roller printing m/c.
5. Flat screens are economical for printing short run design as compared to roller and rotary machine.
6. Important for printing handkerchiefs, scarfs etc cross border sarees, table- clothes.
7. Big repeats are possible (50-450 mm).
8. Sharpness of print is very good .

1.4 Limitations of screen printing:-

1. Joint marks are visible (but may be avoided artistry design to coverup that joint by flowers,motifs etc.

2. Since operation is intemittent (unlike the continuous process of roller and rotary) the production is less.

Ch –2 Rotary screen printing

In these m/c, rotary screens are used. Most of present rotary printing m/c's are based on same principles mechanical and difference is there in print paste applications i.e use of squeegee. There are 2 methods :

I :-by using rubber blades of different hardness, feeding paste to this blade and by applying pressure, pushing paste through screens onto cloth.

II : – magnetic roll system activated by electromagnets under table. The colour is passed through a steel rod, (depending on size of rod and amount of pull applied by magnet) more or less paste is put on cloth.

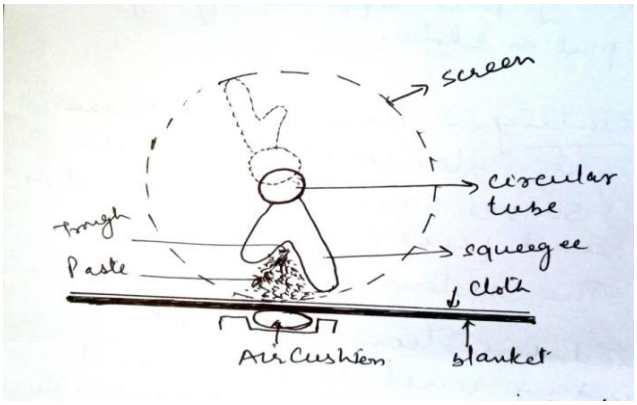
1.Buser rotary screen printing :-

Each rotary screen is provided with a highly flexible steel pressure plate. There is ***swivel squeegee system*** 'which helps to save cloth and print paste at the start and end of printing .'

The system consist of colour tube. Colour basin and insertion blade. It moves up when printing unit is raised and is hydrolytically moved down into working position when printing unit is lowered. The doctor blade is inserted in screen facing upward. When printing starts ,the wiper unit performs a half turn and is lowered together with screen onto the cloth with (air cushions) for even application of paste over the entire width of m/c.

The m/c is available in different standard widths 72", 94'' and 11O'' and in lengths. For up 12, 16 or 20 colours. Thermoplastic gluing or ordinary gums may be used. Printing speed is 5-10 yd/min..
The high capacity jet dryer for tension less process are provided .
Interchangeable rubber squeegee , very accurate paste level control, ease of lengthwise -x-wise and diagonal registration , air cusion systems are provided .

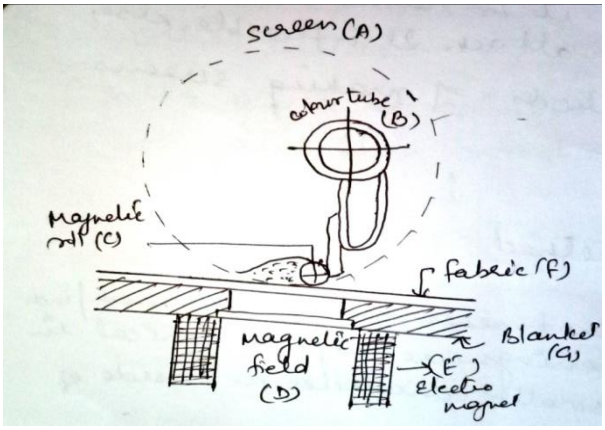
Swivel squeegee system :--



As said earlier, when printing starts, the squeegee is automatically turned into the correct position forapplication of the paste. Meanwhile the paste is pumped into tube, regulated by a paste level feeler. When the m/c stops, the squeegee swings upwards by 180 degree allowing the paste to collect in a pocket. The paste is then feed back into the feed tank. When m/c is started again, the squeegee reverts to its working condition for printing.

*This system ensures prevention of paste seeping through the screen.

Magnetic squeegee system for zimmer screen printing m/c:-



in interior of screen(A) are colour tube(B) and a magnetic roll(C)which is attracted by magnetic field produced by electromagnetic field produce by electromagnet(E) and which roll inside the screen when screen rotates , thereby effecting transfer of print paste. The cloth (F) glved to blanket G.
The paste is supplied automatically by pumps and level gauges through at tube inside screen. It permets repeat of 57-100cm. glved is transferred through pump. A steel docter knife attached to beam. Distributes glve. Uniformly ones the hole fabric.

Advantages of magnetic roll:-

a) Magnetic roll can be changed during printing without stoping m/c.
b) Amount of paste transferred depends upon dia of magnetic roll.
c) Uniform pressure is exerted across while width of cloth.
d) Screens can be last longer due to less friction b/w roll and screen .
e) The squeegee does nail need sharpening.
f) By rolling magnetic roll within screen, high pressure can be generated.

Preparation of rotary screens:-

Nickel is suitable for construction of screens as it is resistant to mechanical wear as well as chemical attack. It is flexible also. There are following method of making screens.

(1) Emulsion lacquering
(2) Laser engraving
(3) Galvanoplasty method

1. **Emulsion lacquering** :- for these screen fineness of 60,80 or 100 mesh/inch are suitable. The openings are approx. conical in shape and have a smaller diameter of inside of screen cylinder than of outside.
The patterns are transferred by the photochemical method with a photosensitive hardening lacquer.
The process is

Degreasing

Suctioning off.

Stiffening by auxiliary rings

Air drying

Coating with sensitised hardening screen lacquer

Drying at 18-20degree celcius,60%RH

Coating & drying (repeated thrice)

Exposure to light

Developing (washing at 10-25dregee Celsius for 15-30min)

Drying

Application of hardness soln

Retouching

Preliminary hardening

Subsequent hardening

Retouching

Retouching and gluing of end rings.

Degreasing:- The surface of rotary screen as cleaned up to free it from any grease or other residue. For this screen are first treated with an acid solution and then with alkaline soln. and then washed with water.

Screen is put down for a min and suction treated while still wet. This removes any residue of cleaning soln.

Coating :- photosensitive solution is applied and dried for 5-10min in drybox in air (28degree Celsius). The drying should be carried out as quickly as possible

The coated screen may be stored for 7-10hro before exposure.

Exposure :- The screen are exposed to light. The light source should develop its maximum power.. The temperature of screen & -ve should not exceed 28degree Celsius .

Developing :- After exposure, developing is carried out immediately by immersing screens horizontally in water for 3-6 min.
During this soaking, unexposed portion became detached . The undetached portion are removed by rinsing using water jets.

After rinsing screen are dried at 30degree Celsius for 10-30 sec

The screens are baked at 140degree Celsius for 1 hr to harden lacquer.

2 .Laser engraving :- This is based on stepwise evaporation of emulsion layer on perforated screen with a low cost, low energy laser beam . It gives a perfect screen.It involves digitalising an image and then engraving it on a screen by means of laser beam monitored by computer. i.e

Scanning ⟶ enlargement or reduction ⟶ Projection ⟶ instruction ⟶ laser engraving .

(1) In 1st step the image is to be engraved is initially scanned and digitized.
(2) After scanning, enlargement or reduction can be effected in both X and Y directions.
(3) The design can be projected on a colour monitor for colour changes and checking of design.
(4) The desigh is then stored in a magnetic tape in digitalized code which instruct laser beam with high accuracy.

(5) A laser unit of capable of generating and reducing a laser beam from 12mm dia to a beam of 15mm dia is controlled by computer since computer divides the screen circumference into 360degree , the image is always distributed equally. The time taken for engraving depend upon screen diameter ,design requirement and screen mesh e.g based on screen of type 64/1850 an average of 13min. is required.

Advantage :- technological, economical, high speed, accuracy etc .

3.Galvanoscreens :-

Galvano screen are electro-formed on either stainless steel , nickel-plated steel or expandable nickel mandrels.

The mandrel (which is used for engraving and nickel -electro forming) is manufactured to extract inner circumference of printing rotary screens. It may be used again.

The engraving procedure is similar to photo-engraving of copper rollers.

Mandrel is thoroughly cleaned.

↓

It is coated with photo senitiser .

↓

Dried in oven.

↓

The roller in contact with film (positive or negative) exposed to light from a high intensity source

↓

Imagee Is developed ,washed,tinted and retouched.

It is ready for electroplating. (mandrel has photosensitive In all designed portion)

Now , It is placed in Potassium Dichromate sol. where Nickel screen is separated/ detached from mandrel after electroplating is complete . Thus rotary screen formed in this way after inspection, end rings are mounted on rotary screen.

Advantages:- It is a pure metal screen and there is no emulsion to break down. Pin holes problems are absolutely minimised.

Ch.-3 Printing Of Wool & Silk Fabric

Preparation Of Wool for printing:-----

Scouring——>bleaching——>chlorination

a) **SCOURING:-** is done by pre washing of wool in rope form in hot water and then soaping 10-15% marseilles soap at 60^0c for 30 min & then washing with water & hydroextracting .
b) **Bleaching:-** is done in 2-3 vol H_2O_2 with ammonia and rolled in wet state and allowed is lie for 24 hrs .Then washing and treating with sod.bisulphite and then further treatment with 2-2.5^0 Tw sulphuric acid and the finally washing.
c) **Chlorination:-** it enhances the affinity of fiber for dyes and reduces its felting properties.The degree of chlorination determines the colour yield, brilliance of shade and levelness of print .Greater the degree of chlorination, greater will be dye uptake. But over chlorination should not be done since wool may get yellow. The fabric is treated in a chlorination tank consisting of-

2000 lit	water
12-20 lit	bleaching powder
8-25 lit	HCl (32^0Tw)

The bath is is replenished by

750 ml-2-5 lit	bleaching soln.
4-5 -1.5 lit	water
500 ml- 1.5 lit	HCl acid

After each piece of cloth is passed , The cloth is then washed ,treated with glycerin and dried.

The choice of dye depends on requirement of printed cloth eg.

- **Acid dye:-** produce bright prints ,but fastness properties are not satisfactory.
- **Metal complex dyes:-** exhibit very good fastness ,but shades are not bright
- **Chrome dyes:-** limited use because of fastness and insufficient brightness of shade
- **Reactive dyes:-** specially designed for wool & silk printing e.g cibacron and lanasol dyes give very bright shade of high tinctorial value, perfect penetration & excellent levelness.

Thickeners used may be British gums ,gum tragacanth, low viscosity alginates, emulsion thickness.

Other ingredients may be wetting agents, acids and fixation aids. Urea is not always used as it harshens the wool.

Printing with acid dyes:-

Thickeners used are Senegal, gum tragacanth, British gum. Starch is not used as it requires thorough soaping for removals and if not removed,it produces harsh feel to the fabric.

The printing paste contains:-

Acid dye	30 gm
Glycerine	50 gm
Water	320 gm
Gum Senegal	500 gm
Acetic acid	50 ml
Tartaric acid	30 ml

	1000 gm

Cloth is printed ⟶ dried at moderated temp. ⟶ steamed for 45-60 min. ⟶ washed ⟶ Dried

Printing with chrome dyes:-

Here strong organic acids like oxalic ,tartaric ,glycolic, formic and acetic acid are used.

Mordant used are chromium acetate or flouride.

Printing paste contain:-

Chrome dye	30 gm
Glycerine	30 gm
British gum ,tragacanth paste	580 gm
Oxalic acid	25 gm
Chromium acetate solution	120 gm
Water	65 gm
	---
	1 kg

Printing ⟶ drying ⟶ steaming

Printing with metal complex dyes:-

These dyes contain chromium in their molecular structure. These are applied under strong acidic conditions and steaming is done under less acidic conditions. chromium salt is added for better fixation.

Printing paste contain:-

Dye	10-30 gm
Water	310-370 gm
British gum	550 gm
Glycerin	50 gm
Chromium Acetate soln.	20-60 ml

The cloth is printed ⟶ dried at moderate temp and steamed for 45-60 min at atmospheric pressure ⟶ washed & dried

Printing with cibacron dyes :-

Printing paste contain:-

cibacron dye	20-30 gm
urea & sodium alginate thickening	200 gm
AlbatexBD/Ludigol	10 gm(for protection of dye)

Fabric is printed ⟶ dried ⟶ steamed for 10-15 min ⟶ rinsed with cold and then hot at 60–70^{0}C ⟶ after treatment with 2 ml ammonia at PH 9 and then neutralization with 1 ml formic acid

Printing with Lanasol dyes:-

These reactive dyes are developed for animal fibers (wool & silk),produce very bright shades of very good light & wet fastness. These are highly reactive but differs in its constitution from that of triazynyl reactive dyes.

The printing paste contain

Lanasol Dye	20 gm
Urea	100 gm
Lyoprint G	100 gm
Acetic acid	50 gm
Albatex BD	10 gm
Water	210—290 gm
Thickener	500 gm
Cibaphasol A	10—30 gm

Locust beam gum derivatives are used .

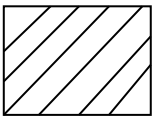
The reduction thickening may be prepared as:-

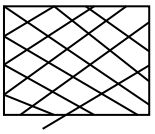
50 gm – urea
50 gm – lyoprinting
50 gm – albatex RD
315-305 gm – water
550 gm—thickening
5-15 gm – cibaphasol AS
25 gm – acetic acid
1 kg

Print ⟶ dry ⟶ fix by steaming for 15-20 min at 102.c – 103.c ⟶ rinse with cold water ⟶ Washing at 80^{0}C in 2 ml ammonia & 1 g/l ultravan AN ⟶ washing ⟶ drying

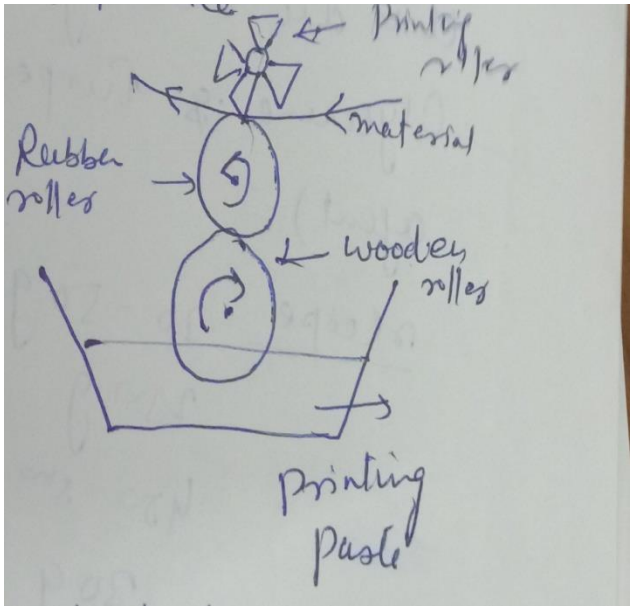
Vigoureux printing or melange printing:-

In this proces sliver is printed for getting mixture effect. The **melange yarn** is defined as that produced from coloured printed tops or sliver . In this are deagonal or cross wise stripes are printed.





Diagram



The inventor of the process was Jacques Stanis as Vigoureaux of Rheims, France.

Principal:- A wooden roller partially immersed in printing paste (in wooden or s.s trough) rotates against a felt covered rubber roller. A doctor blade removes surplus printing paste (not shown) and ensures even distribution. A printing roller (which has on its surface elevated ribs inclined at an angle to the axis) is placed above and in contact with felt covered rubber roller . A thin web of sliver passes between the two upper roller . The pressure of ribs of printing roller transfers prints on to the fibre . No transfer of paste takes place where no pressure is applied in spaces between ribs.

This process gives a more intimate blend of coloured and uncoloured fibre. softer handle is obtained with the finished cloth. This effect can not be produced by blending dyed and undyed fibers.

Acid ,Chrome & melal complex dyes are commonly used in vigoreaux printing of wool slivers. British gum is suitable thickener. Other ingredients used in this are wetting agents, Sod. Chlorate, Glycerin & Turpentine or silicon (as antifoaming agent)

Recipe:-

30 – 50 gm – Dye
250 gm – British gum
450 – 500 gm – Water
30 gm – Glycerine
10 gm – Sod. Chlorate
10 gm – Invadine BL
10 gm – Oxalic acid
90 –110 gm – Chromium Acetate

Print $\longrightarrow$ dry $\longrightarrow$ steaming for 60 – 90 min at 104 – 108°C $\longrightarrow$ cooling $\longrightarrow$ backwashing as In

i. Batch $\longrightarrow$ water at 30° c
ii. Batch $\longrightarrow$ 1 gpl sandozin N at 40°c
iii. Batch $\longrightarrow$ water at 40° c
iv. Batch $\longrightarrow$ water at 30°c

Chapter 4 Printing of Cellulose Acetate

Preparation of Acetate fabric:-
CA and CTA fibres are saponified with alkali. Severe Conditions are avoided.

Desizing:- desizing is carried out at 50 to 60 degree Celsius either with enzymes or non ionic detergent.
Scouring:- the goods are scoured in a bath containing

1-2 gpl An/Ionic detergent
1-2 gpl trisodium phosphate(TSP)

At 60 degree Celsius for 30 minutes and washed with cold water.
Heat setting:- heat setting in cellulose Acetate fabrics produce stiffness due to slight filament Cohesion. It can be avoided by controlled Mild saponification is carried out with caustic soda(3gl) 80 to 90 degree Celsius for 2 hours.
Heat Setting of Cellulose acetate is carried out after printing.

Cellulose Acetate resembles the synthetic fibre in its capacity for being set on heat setting. On heat Setting the fabric becomes resistant to creasing during laundring. The setting is carried out using steam or dry heat process. The fabric is set in steam at 1- 1.2kg/cm2 pressure for 30 minutes. This is used for cellulose Acetate garments. Dry heat setting is carried out on a stenter 190-210 degree Celsius for 30-90 seconds. Dry heat setting decreases in the rate of dyeing.

Bleaching:-

Bleaching is optional for Acetate fibres. It can be carried out for full white goods and to remove slight yellowing produced during heat setting.

Sodium chlorite bleaching is carried out using sodium chlorite(1-2gpl) and acetic acid(1-2gpl) at 80 degree Celsius for 30 minutes. The goods are then washed.

The fabric is ready for printing.

Cellulose acetate Is a thermoplastic fibre relatively hydrophobic in nature and it's coloration depends on the use of special class of dyes. Disperse dyes are most widely used dye for printing on cellulose acetate. This give sharp, bright prints with good fastness properties.

Printing paste consists of

20-70 parts - disperse dye

320-370 parts - water

500-600 parts - thickening agent

50 parts -ludigol (resist salt)

10 parts- levelling agent

Resist salt is used to prevent reduction during steaming. Levelling agent also prevents foaming.

The most suitable thickeners are mixture of gum Arabic and crystal gum in ratio1:1,locust bean gum. Emulsion thickening can also be used.

After printing, cellulose acetate goods are steamed with saturated steam(100-102 degree Celsius) for 45 to 60 minutes. In case of cellulose acetate, steaming at pressure of 1-1.5kg/cm2 for 30 minutes gives good result. Thermo fixation is not suitable due to tendering of fibre in that conditions.

The steamed fabric may be thoroughly rinsed in cold water and then washed at 40 to 50 degree Celsius with detergent(0.5-1gpl).

Chapter – 5 Printing of Polyamide fibres

5.1 Preparation of fabric

Nylon fabric has spin finishes, oils, tinting colours and dirt that is easily removed by scouring with Sodium Carbonate and non ionic detergent at 70 degrees for 30 minutes to 1 hour.

5.1.1 Heat setting

Nylon fabric is heat set for 30 to 45 seconds at 120 to 200 degree Celsius depending upon the type of Yarns, type of heat set i.e. pressure steaming or dry heat setting. The temperature influences the dye uptake, rate of dyeing etc.

5.1.2 Bleaching

Nylon has a good natural whiteness and is not bleached except when slight yellowing caused by heat setting has to be removed .Sodium chloride is best bleaching agent for good whiteness without damaging the nylon material.

The bleaching is carried out using

1 to 2.5 gpl	Sod. Chlorite
1 to 2 gpl	Sod. Nitrate
2 gpl	Formic acid
pH	4
Temp	70
Time	60 to 90 min.

Material is washed with hot and cold water and is treated with antichlor (sod. bisulfite 1 to 2 GPL at 50 degrees for 30 minutes then finally washing is carried out with cold water.

5.2 . Printing of polyamide

A considerable portion of polyamide textiles is printed to produce fancy colour effect. Printing on these fabric differs from dyeing of these fibres in following respects

1. Dyes of various classes can be applied in in conjunction with each other.
2. Barrenness of material is of little significance.
3. No blocking effect occur.
4. Colour build up is of great importance in producing full shades.
5. Fastness to water , seawater perspiration and chlorine is most essential to the fabrics.

Acid and metal Complex dyes are usually applied for direct printing of polyamide textiles. Disperse dyes show poorer wet fastness on polyamide and not satisfactory for these goods. Acid dyes give brilliant prints and a few exhibit all round fastness properties on nylon 6 and nylon 66. Metal Complex dyes produce very high fastness properties but the prints are dull.

Because of smooth cylindrical fibre structure and low swelling properties of polyamide fibers sorption of aq. solution and pastes by the fabric is very poor so it is necessary to use printing rollers with shallow engraving so that all the paste in engraved design is taken up by the fibre. Thickening agents of high solid content are best suited.. Crystal gum is preferred. Locust Bean gum, guar gum or sodium alginate are also used. ThioDiethylene glycol act as a solvent, a hygroscopic substance and as swelling agent for polyamide fibers

.

5.2.1 .Printing with acid and metal Complex dyes

The printing paste consists of

5 to 50 parts	acid or metal Complex dye
50 parts	Urea
30 to 50 parts	thioethylene glycol

200 to 265 parts	boiling water
600 parts	crystal gum thickening
5 parts	Ammonium Sulphate
O to1 part	antifoaming agent.

Goods are printed dried hard and steamed at 103 to 105 degree centigrade for 20 to 40 minutes After steaming. the goods are rinsed with cold and hot water followed by soaping at 40 to 60 degrees with non ionic detergent and sodium carbonate. For fastness after treatment with suitable agents may be given.
The printing with acid/metal Complex dyes causes the staining of white ground during washing off.. This may be avoided by treating with cibatex PA before printing or it may be added during washing off.

5.2.2 Printing with disperse dyes

Disperse dyes are used principally for producing prints of medium and pale Shades these have leveling properties and hence are of suitable for block print
The print paste consists of

X parts	disperse dyes
Y parts	water
200-300 parts	Urea
400-600 parts	thickening
1 part	wetting agent

Thickening based on crystal Gum Gum indalca etc can be used. The fixation of prints on polyamide can be carried out by:----

5.2.2 a)Pressure steaming:
The printed goods are steamed using steam at pressure of 0.5 kg per CM square for 30 minutes increasing pressure of steaming do not increase colour depth while lower atmosphere pressure results in lower colour yield.

b) Superheated steaming
This gives the best results of colour yield and pleasant feel to the fabric. fixation is carried out at a temperature of 160 190 degrees for a period of 1 to 6 minutes.

c) Dry heat fixation
The fixation is carried out by heating the fabric to 170 -200 degrees for 1-2 min. In a pin stenter .The feel of Fabric becomes harsh on thermo fixation. The goods are then washed with cold water and then by detergent at 60° .Finally washing with water is done.

5.2.3 Printing with reactive dyes

Hot brand reactive dyes can be fixed on polyamide at ph 7.5 .If a mix. Of Diammonium Citrate and Sodium Bicarbonate is added to printing paste., the ph of dye changes during steaming from neutral to alkaline. This facilitates the fixation of dye on polyamide. This is also suitable for printing polyester cotton blends.
The printing paste consists of

30 50 grams	reactive dye
500 parts	sodium alginate of low viscosity
350 parts	solution of (40 grams of sodium bicarbonate plus 190 gm water)
50 parts	lyoprint G
100 gm	water

The fabric is printed with paste ,dried and pressure steamed for 45 minutes at 11 psi and washed by cold rinse

and then by hot rinse.

Vinyl sulfone dyes can also be used. The fabric printed with these dyes can be washed at boil. These do not stain white ground .
Best results are obtained at ph 7 to 9 with fixing agent Ramazol salt D. Printing paste is stable in presence of this agent

The printing paste consist of

60 100 parts	Ramazol dye
200 parts	boiling water
500 parts	thickener
30 parts	ludigol

after printing and drying the cloth his steamed for 20 minutes at 7 psi. Then cold rinsed and treated at 60 degrees with 18 gpl non-ionic detergent.

5.3. Printing of Triacetate/ Polyamide blend fabrics

5.3.1 Disperse and acid or metal Complex dyes can be used in printing this blend. The selection of disperse dye for triacetate is adequate but the shades obtained on polyamide exhibit unsatisfactory wet fastness. Better fastness are obtained with acid and metal complex.
Swelling agents should be added to fix these dyes on tri-acetate. But their effect on polyamide component (causing shrinkage) is also considered. Thio urea and glycine PDA(BASF) are used as swelling agent.
Amount of glycine PFD increases colour yield but also causes flushing..

Printing paste consists of:-

Acid aur metal Complex dyes	Xgm
Glycine PFD	50-100gm
Thiourea	80 gm
Locust Beam Gum	550 gm
Total	1kg

After printing and drying, the fabric may be steamed for 20 minutes atmospheric pressure. It is then released in cold water, soap(1-2gpl detergent) at 50 to 60 degree Celsius. Finally washed and dried.

5.3.2 Cationic dyes

These dyes give very bright print on polyamide fibre. Light fastness sometime is not satisfactory.

The printing paste consists of

10gm	cationic dye
30g	Lyoprint G
330gm	Water
630gm	Gum Tragacanth
1Kg	total

The cloth is printed,dried and steamed for 15 to 20 minutes, rinsed in cold, soaped at 50 degree Celsius washed and dried.

CHAPTER 6 Printing of polyester Fabrics

Disperse dyes are the most suitable for printing on polyester fabric. Selected dyes with good steaming and thermofixation are suitable.Liquid form of disperse dyes are suitable for printing.

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For preparation of PET fabric the processes like singeing ,desizing, chlorite bleaching, mercersing and drying Should be carried out.

6.1 Direct style of printing :-

The polyester fabric is printed with disperse dyes .The printing paste contains

Disperse dye –	10-100 parts
Water --	100 parts
Sodium chlorate –	5 parts
Thickener –	700 parts
Citric acid for ph ---	x parts
	1000 parts

Sodium chlorate protects the brightness of print against any possible reduction of dye under prolonged steaming Condition for ph 5-6. Organic acid such as citric or tartaric acid can be used. If acetic acid is used then ammonium Sulphate is also used as acid liberating agent.

Disperse dyes for printing should have good fastness to sublimation and good dispersion properties. The liquid Dye is preferred for this. It should be thoroughly shaken before use

6.1.1 Suitable thickeners for printing are –

A) Esterified gum with low viscosity, locust beam gum or guar gum
B) Low viscosity sodium alginate
C) Mixture of emulsion thickening & sodium alginate thickening

Requirement of thickener: -

1) Thickener film should adhere well to fabric and should produce an elastic film to prevent cracking, Splintering and dusting off.
2) Level prints with sharp art line should be produced.
3) Easily removable during washing

Not all thickeners completely fulfil the requirement so mix. of thickener produce require print . The disperse Dyes are printed under mild acidic conditions and thickener should be stable and soluble under these conditions. Synthetic thickeners based on polymerized acrylic or maleic acid are also suitable. These thickeners are effective at low concentration & are easy to remove. The thickeners are sensitive to electrolytes and hence, the use of electrolytes are avoided in printing paste.

It is not necessary to penetrate the paste inside the fabric. It is preferable to deposit the dye paste on the surface of fabric so that dye diffuses in to the fabric during fixation step. The deeper penetration of paste causes marks on cloth in roller printing. So to avoid deep penetration of prints the mesh of screen printing machine is extremely fine, and the rollers of roller printing machine are engraved shallow.

After printing and drying the fabric may be

a) steamed for 30 min at 23 psi (125-130°c) (High temp steaming)
b) Hot air fixation (thermosoling)

- 180-190°c per/ min (for pale shade)
- 190-200°c per/ min. (for satin factory sublimation fastness dyes)
- 205-210°c per/ min. (for high sublimate)

Then the fabric is rinsed well to remove thickenert and reduction cleared in a bath containing

3 ml	NaoH
2 gm	Sodium Hydrosulphite
1 ml	Wetting agent

The cloth is then rinsed, soaped at boil washed and dried.

Difference Between superheated steam over hot air.

* The superheated steam is of high heat capacity.,so It gives good dye fixation at lower temp and thus dye with lower sublimation can be used.
* The steaming is carried out under tensionless condition and therefore feel of fabric is very soft.
* The prints are bright.

But the hot air heat fixation has advantages of high productivity and no flushing of printing.

6.2 Discharge style of printing polyester: -

Polyester fabric is dyed with selected dyes suitable for discharge printing by Carrier or HT beam dyeing method. The dye on the fiber is then *destroyed* by printing in order to get a *white discharge* and by simultaneous printing of *other colors* in order to get a *colour discharge*. **Zinc Sulfoxlate Formaldehyde** is used as *discharging agen*t for *white discharge* and **tin salt** is used for *color discharge*.

The dyed fabric is

printed with printing paste of thickener (locust beam gum)

Carrier –	50-100 parts
Sodium thiocyanate –	40 parts
Solvent –	100 parts
Zinc sulfoxylate formaldehyde –	200-300 parts
Citric acid –	20 parts

(For coloured discharge, discharge resistant disperse dye is added in printing paste and tin salt (100-200 parts) in place of zinc sulfoxlate formaldehyde is added)

Fabric is dryed → fix by steaming at pressure of 1.4 kg /cm2 for 20-30 min → washing with suitable detergent at 60°c → cold washing →reduction cleaning at 60°c → final rinsing with cold water → drying.

Chapter 7 Printing of P/C , P/V blends

7.1 Direct style of printing P/C blend textiles:- A no of difficulties have been encountered in printing these blend because of entirely different characteristics of the two component fibers . Dyes that can fix on both fibers are not fully developed and only a selected mixture of dyes from disperse, vat, direct or reactive classes is used . The conditions in printing paste and on the fiber during fix are not always favourable with the mixtures of the two types of dyes .

7.1. 1.Disperse – Reactive dyes: - This combination gives bright prints with excellent wet fastness without affectin handle of fabric. The cost is high light fastness is not always good. These can be applied by single phase and double phase method.

7.1.1.a) Single phase: - the fabric is printed with

X parts – disperse dye
Y parts – Reactive dye
600-700 parts – sodium alginate or emulsion thickening
2-10 parts – sodium bicarbonate
50-10 parts – resist salt
1-2parts – wetting agent

After printing. the fabric is steamed under pressure of 25 psi (130°c) for 30 min or by themofixation at 210°c for 40 sec.

White selecting disperse dyes,

1. The alkali sensitivity of these dyes should be considered.
2. Sublimation behaviour (in Thermofiaxtion process)

On the other hand same reactive dyes are sensitive to high temp in presence of alkali.
These can be controlled by adding lower amount of Sod.Bicarbonate to the printing paste.

In this case colours yield is not very good. So it is preferable to have a **two stage** fix process in order to get excellent colour yield ,brightness of shade, absence of staining of white ground.

7.1.1.b) Two – phase method:- in this method the printing paste does not contain alkali . The other advantage is that disperse & reactive are fixed in sequence. Disperse is fixed first followed by fixation of reactive dye in alkaline medium . The alkali free printing paste is more stable & there is wide variety of disperse dyes .
The printing paste consist of

X parts – disperse dyes
Y parts – Reactive dye
600-700 parts – thickener
5-10 parts -- Resist salt
1-2 parts – wetting agent
1-2 parts – acetic acid
1000 parts -Total

The blends are printed, dried and thermofixed at 190-210°c for 60-80 sec.

& then chemical padded with

4-6% - NaOH
10-15% - Na_2CO_3
15-20% - NaCL

Fix by steaming at 120°c for 30-60 sec (flash ageing) → soaped washed & dried.

7.1.2 Printing of polyester with disperse/ vat dyes: -

Prints with good fastness can be obtained by this combination.
The component dyes are fixed by two phase method. The pastes are prepared separately and mixed prior to printing.
The disperse dye paste contains.

X parts – vat dye
15parts – water
2 Parts glycine A (Thiodiethylene glycol)
1 part Resist salt
Y parts – Thickener

The Vat Dye paste contains

X2 parts –vat dye
20 parts –water
Y2 parts - Thickener

After mixing these 2 in required proportion.
The resulted paste is printed on fabric. Then the fabric is dried. Thermofixed at 180-200°c for 40-50 sec.
Then the fabric is padded with a solution of

120 parts -NaOH
80-100 parts – rongalite C
10 parts - Borax
100 parts – glauber salt.

The fabric is flash aged at 103-105°c for 40-50 sec then further oxidation & soaping is carried out.

7.1.3 Disperse/solublised vat dye:-

in this the disperse dye is fixed by thermofixed and solublised vat dyes is developed by sodium chloride / Nitrite process.

The stock thickening may consist of

2 parts – sodium nitrate
1 parts – Noigen EL
X part – water
Y parts – thickening

4parts – sodium chloride
2parts – ammonia sulfocynide
1 parts – ammonium vanadate
1 parts – liquid ammonia
X part – water
Y parts – thickening

Total - 100 parts

The printing paste may contain

X parts – Disperse dye
Y parts – soluble vat dye
5parts – thiourea
5parts – glycine A
15-20 parts – water

Z parts-stock thickening
100 parts- Total

The fabric is printed, dried and steamed under pressure of 25 psi (130°c) for 30 min . Then fabric is passed through sulphuric acid solution (20g/l) at 60°c for 30-40 sec, rinsed, soaped (2 gpl nonionic detergent) for 15- 20 min , washed and dried.

7.2 Pigment printing on PET/Celloluse blend:-

Resin bonded pigment are **suitable** because of

a) Same pigment are for any blend, polyester & cotton do not need separate pigments.
b) Low cost of printing.
c) Simple process.
d) Sightings of pattern is immediate

Drawbacks:-

a) Poor rubbing fastness particularly in heavy shades
b) Objectionable stiff handle
c) Drycleaning fastness is poor of some pigment

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The selection of binder and pigment is necessary for good fastness . The most commonly used for cotton fabric are not suitable for P/C blend because of their poor adhesion to the polyester due to circular X- section and passivity of polyester. So specially developed **styrene butadiene and acrylonitrite butadiene binder** are employed. Optimum quality is used because too much stiffens the fabric and too little gives prints of poor fastness . These is still no binder that will penetrate deep into polyester fiber, most of pigment binder sol remains on surface ,so it is not possible to get satisfactory print in heavy shades with good rubbing fastness.
The fabric is printed with.

X parts – pigment
Y parts – binder
500-700 – emulsion thickening
1-5 parts – Acid liberating agent

Then fabric is dried and cured at 160-170° c for 4-5 min

A final washing is done then

in order to overcome poor rubbing fastness in deep shades, a mixture of pigment and disperse dye is used .

The printing paste then contains disperse dye with the above printing paste, the prints are dried ,cured at 190-200°C for 45-60 sec and washed . The process is costlier and prints are not very bright and feel of fabric is not also improved.

Chapter – 8 Printing of acrylic fibres

8.1 Pretreatment

8.1.1 Desizing/scouring - acrylic fibre is scoured in a bath of non ionic detergent(1-2gpl) 80 to 85 degree Celsius for 30 to 60 minutes to remove spin finishes, tinting colours and that if any. The goods are then washed.

8.1.2 Bleaching- bleaching is not necessary for acrylic fibre. For extremely white goods bleaching is carried out using

1-2gpl - sodium chlorite

2-4 gpl- sodium nitrate

1-2gpl- formic/ oxalic acid to get pH 4

At 80 to 90 degree Celsius for 30 minutes. The goods are washed , antichlored with sodium thiosulphate(1-2gpl) at 60 degree Celsius for 20 minutes.

8.2 Printing:- *Cationic and disperse dyes* are suitable for printing. Cationic dyes are most important and most widely used on acrylic(anionic-modified). Prints Produced with cationic have excellent wet and rubbing fastness very good light and weathering fastness properties.The Shades are also brilliant.

8.2.1 Printing with Cationic Dyes:.

The printing paste consists of Acetic Acid and tartaric acid to adjust pH of paste.

Fibre swelling agent such as resorcinol, phenol may be added to increase penetration of dye into fibre. Excess use of them may cause bleeding of certain cationic dye.

Sodium chlorate (oxidising agent) may be added to paste to avoid over reduction of dying during steaming. Some of gums (arabic and British gum) have reducing property during storage or during steaming may cause reduction of dye and Resist salt Ludigol being anionic in nature is not compatible with cationic dye so not recommended. So sodium chlorate it is right choice.

Use of solvent thioethylene glycol is added to increase solubility of dye (because swelling agent and oxidizing agent decreases the solubility)

Modified guar gum, gum tragacanth , british Gum etc are suitable thickness for printing acrylic fibre. Some of the thickness such as modified guar gum are alkaline in nature so have to be neutralised with Citric or tartartic acid. So printing paste with cationic dye may be prepared as:-

Xgm - dye

30gm glycine A

10-20gm cyclohexanol

30gm acetic acid

40-270 gm Hot Water

500-600gm Thickner

10-20gm glycine PFD

The dye should be completely dissolved prior to stirring into thickening otherwise improperly mixed dye produce specks in printing.

The acrylic fibre may be printed with the above paste and dried in a hot flue dryer at not more than 100 degree Celsius to avoid yellowing of acrylic fibre.

The prints are then fixed in saturated steam at 100 degree Celsius or in presence of pressure 0.2-0.5 kg/cm2 102-105 degree Celsius for 20 to 30 minutes.

The steamed fabric may be rinsed in cold water, soaped (anionic detergent)1-2 gpl at 60 degree Celsius for 20 to 30 minutes, hot and cold rinse the fabric.

8.2.2 Printing with disperse dye:-

These dyes are of limited use in printing on acrylic fibre because of their limited light fastness. These give subdued shade when printed on acrylic fibre. However Sharp Outlines are produced when selected disperse dyes are used in printing. Selected black disperse dyes are used for sharp outline.

Printing paste may be prepared as:-

1-2 parts - wetting agent

10parts - resist salt

Z parts it - carrier

1000 parts

The fabric is printed, dried, and steam for 35 minutes at 25psi in a cottage steamer followed by thorough cold rinse, soaping at 50 degree Celsius, again rinsing.

8.3. Printing of acrylic fibre blends

8.3.1 Printing of Acrylic/ cotton:-

the printing paste may contain

Xgm- cationic dye

30gm - Thiodiethylene glycol

10gm- acetic acid

150 gm- boiling water

5gm - sodium chlorate

Ygm- thickeners

2gm- reactive dye

The fabric is printed,dried steamed at 103 degree Celsius for 30 to 40 minutes while cationic dye is fixed. Reactive dye is fixed by Alkali pad batch process. This results in production of brilliant prints of good fastness property.

8.3.2.Printing of acrylic/Wool -

The printing paste may contain

Xgm- cationic dye

30gm - Thiodiethylene glycol

10gm- acetic acid

10 gm- phenol

200gm water at 70 degree Celsius

5gm - sodium chlorate

Ygm- thickeners

After printing the fabric is teamed as 103 degree Celsius for 30 minutes, cold rinse, warm rinse, soaping, at 60 degree Celsius for 20 minutes, hot rinse and cold rinse.

8.3.3.Printing of acrylic/ polyamide –

cationic dye or dispersed dye may be used for printing acrylic/ polyamide

The printing paste may contain

Xgm- cationic dye

30gm - Thiodiethylene glycol

15gm- resorcinol

10gm- acetic acid

5gm- tartaric acid

20gm- dissolving salt

200gm water at 70 degree Celsius

5gm - sodium chlorate

Ygm- thickeners

After printing the fabric is teamed as 103 degree Celsius for 30 minutes, cold rinse, warm rinse, soaping, at 60 degree Celsius for 20 minutes, hot rinse and cold rinse.

Disperse dye:-

Xgm- disperse dye

40gm - Thiodiethylene glycol

50gm- urea

200gm water at 70 degree Celsius

5gm - sodium chlorate

Ygm- thickeners

After printing the fabric is teamed as 103 degree Celsius for 40 minutes, cold rinse, warm rinse, soaping, at 60 degree Celsius for 20 minutes, hot rinse and cold rinse.