V

RESULTS AND DISCUSSION

The experimental aspects of this study dealt with techniques for printing to get varying tone effects. Several such designs were thus collected and studied for their general characteristics and effects that they could produce in printing. In the latter part of this study the application of some of these designs were studied experimentally by printing with simpler printing materials like linoleum, spotted rubber, foamy surface of U-foam to get varying effects. These applications were considered further by transfer printing variations with disperse dyes.

The results have been divided into three parts as follows:

I. Designs and their analysis.

II. Illustrations using linoleum, dotted rubber and U-foam as printing materials.

III. Results of the applications of transfer printing as an experimental technique.

I. Designs and their Analysis.

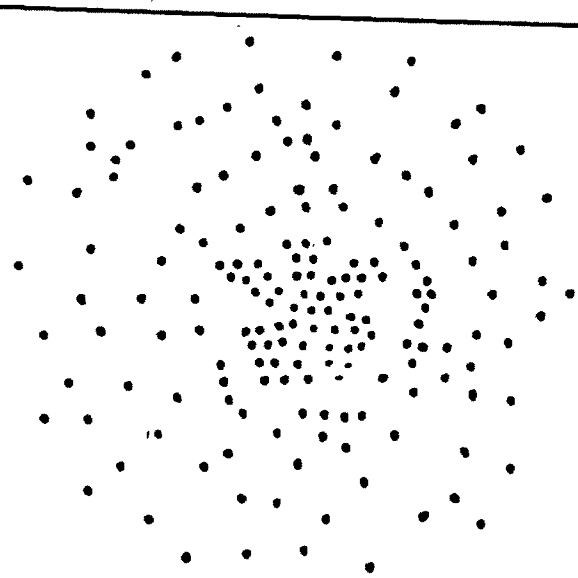
For the first part of the study several designs having shades or tones therein were needed. These were collected from various sources like books, magazines, newspapers, weeklys etc. The designs so collected were modified to get desired tone or shade effects and variations. These are presented along with their analysis in the following pages (Design Nos. 1 to 31).

Design 1: Scattered dots design:

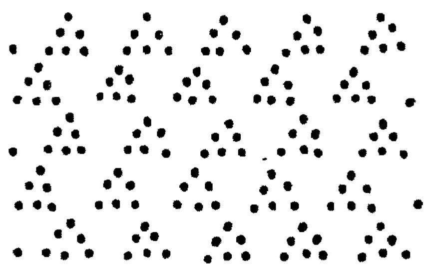
This is obtained by use of dots in a rhythic repetition to give an overall pattern. The dots are closer towards the center and scattered outwards to give an effect of circular radiation. The design is obtained by the repetition of a single element-dot. The emphasis in design is towards the center at the same time the decreasing outward density of dots create an effect of space.

Design 2a: Dotted triangles.

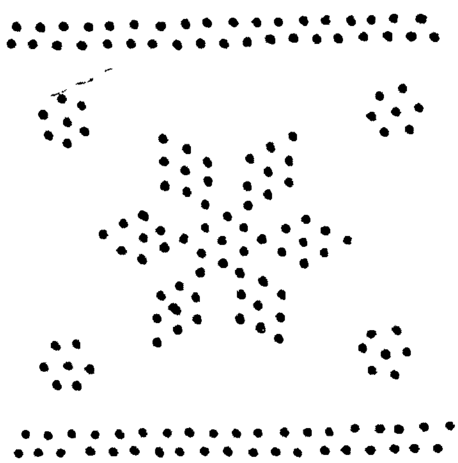
In this design the repetition of dots as unit creates geometric shapes. The movement of these geometric shapes give rhythm to the design. The dots in line give an axial symmetrial balance to the design and also create emphasis by forming the placement of the shape-triangle. This design can be obtained by using rubber with raised dots.



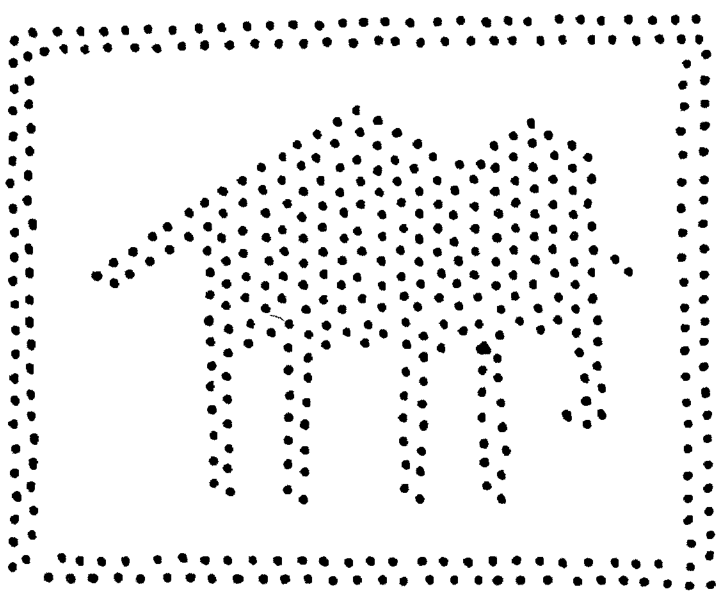
DESIGN 1. SCATTERED DOT DESIGN



DESIGN 2a. DOTTED TRIANGLES



DESIGN 2b FLOWER IN DOTS



DESIGN 2c. STYLIZED ELEPHANT DESIGN IN DOTS

Design 2b: Flower in dots.

The curvilinear dots in lines enclose the shape of a flower with petals. It has a symmetrical balance and individuality.

Unity is seen in this stylized floral motif.

Design 2c: Stylised Elephant design in dots.

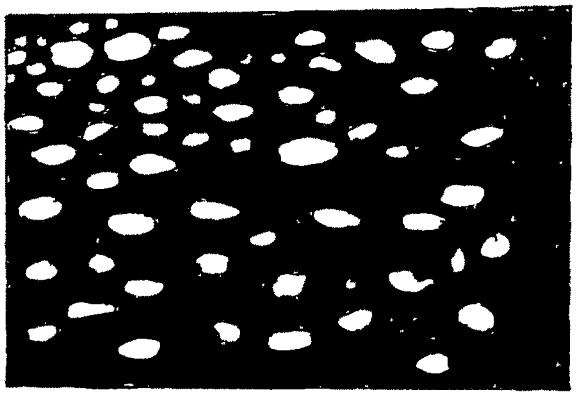
This is a motif of an elephant in a stylized geometrical form obtained by use of dots in lines. Repetition of the dots of the same size create rhythm for the design. This design can be obtained by using rubber with raised dots.

Design 3: Eccentric space design.

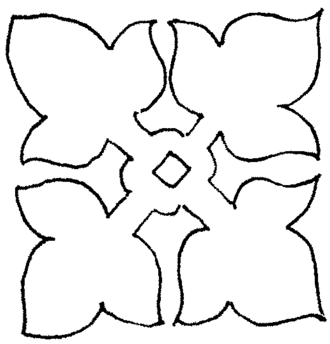
Circular/semi-circular shapes are placed in rhythm for this design. Contrast of values give an illusion of space and depth. An emphasis is thus obtained. This design can be obtained by engraving the linoleum.

Design 4: Stylized leaf design.

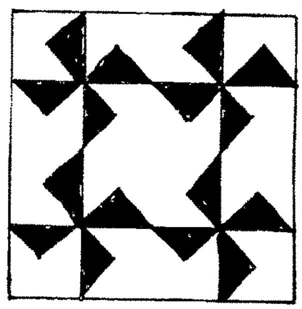
The stylized leaf motif in this design has its origin in nature. Curvilinear lines enclose space and create stylized leaf shape, repetition of which, creates rhythm in the design. The design is radiating from the center towards the edge giving radial symmetrical balance. This design can be obtained in linoleum.



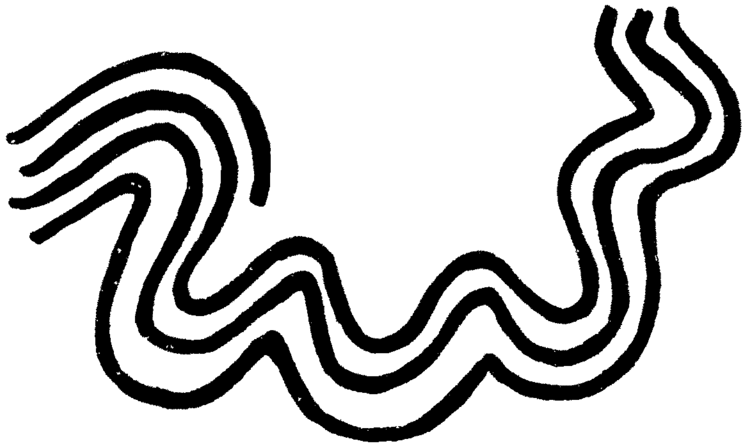
DESIGN 3. ECCENTRIC SPACE DESIGN



DESIGN 4. STYLIZED LEAF DESIGN



DESIGN 5. TRIANGULAR PETAL FLOWER



DESIGN 6. WAVE DESIGN

Design 5: Triangular petal flower.

This is a geometrical design in form of repeats of a triangle to stimulate petals of a flower. The more or less spacing of these in the repetition can create rhythm. The design has an symmetrical balance. This design can be obtained on linoleum.

Design 6: Wavy design.

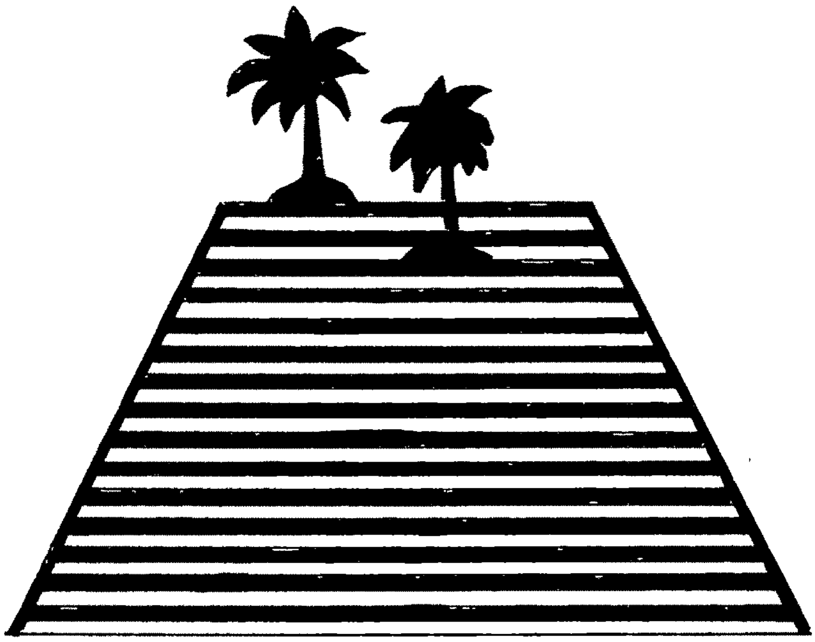
This design made by curvilinear lines suggest movement and agitation. Rhythm is created by the feeling of flow on the surface. The curvilinear lines create an symmetrical balance. The design suggests waves. This design can be obtained by linoleum.

Design 7: Designs showing depth.

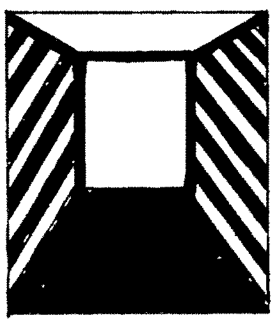
The illusionary effect of depth is created in the design. The lines decreasing in length from the sides are placed equidistant to each other creating depth. The repetition of lines gives rhythm to the design. The trees help to give depth and emphasis to the design (No.7a).

Design 7a:

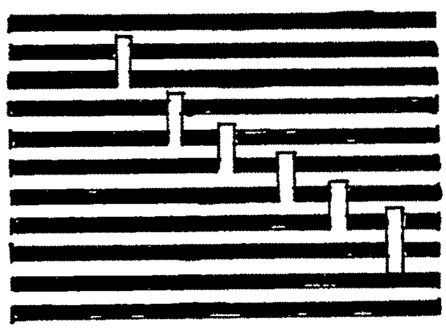
This design shows depth. Depth is created by changing the angles of the lines and the value. Repetition of lines creates rhythm. Symmetrical balance is seen. The center



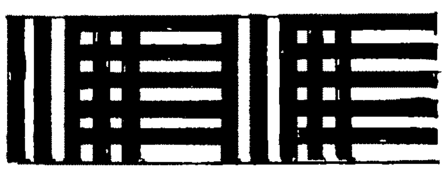
DESIGN 7. DESIGN SHOWING DEPTH



DESIGN 7a. DESIGN SHOWING DEPTH



DESIGN 7b. DESIGN SHOWING DEPTH



DESIGN 8. VERTICAL & HORIZONTAL LINE DESIGN.

rectangle which is left white is emphasized as it creates depth and an illusion of the lines moving towards the center is created.

Design 7b:

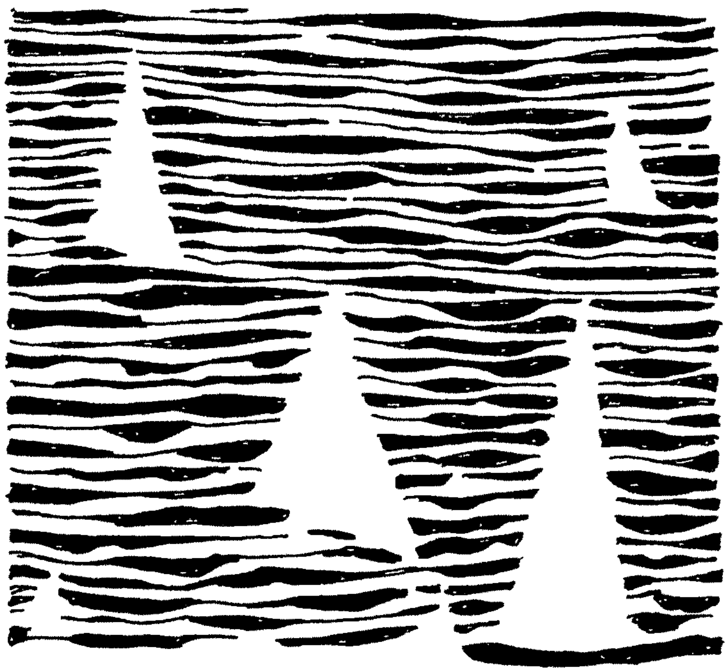
This design gives an optical illusion of depth created by interrupting the horizontal lines by obstacles. Repetition of lines give thythm. It has an symmetrical balance. Emphasis is on the obstacle i.e. the vertical rectangles which give an effect of depth. This design can be obtained on linoleum.

Design 8: Vertical and Horizontal line design.

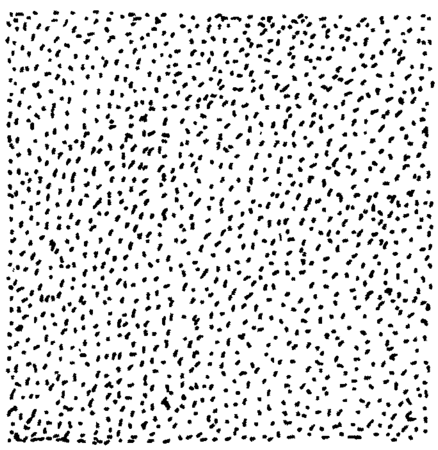
This is an geometrical design. Two sets of lines horizontal and vertical are used. The vertical lines are superimposed by the horizontal lines, creating a two-tone effect. Rhythm is obtained by repetition of lines. This design can be obtained by linoleum.

Design 9: Sailing boats design.

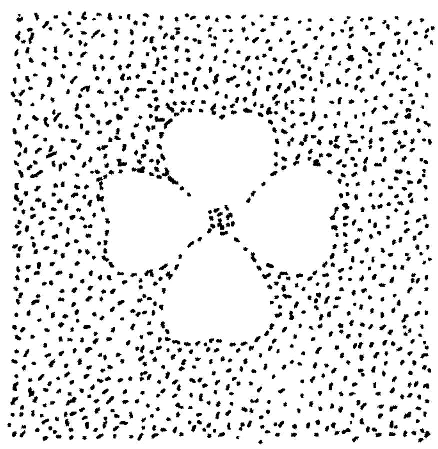
This design is made up of lines the width is randomly varied to get ~~waviness/movement~~. The empty spaces left as triangles give an illusion of boats sailing. The triangles of different sizes create an asymmetrical balance as well as an emphasis. Linoleum can be used to obtain this design.



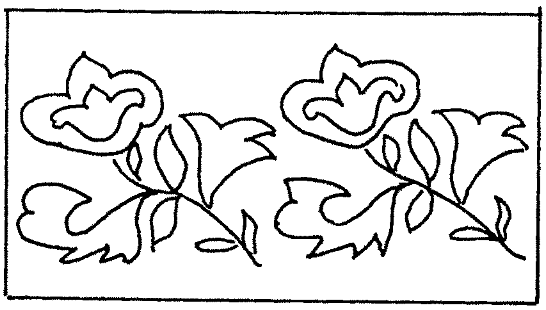
DESIGN 9. SAILING BOATS DESIGN



DESIGN 10. SPECKLED DOT DESIGN



DESIGN 10a. SPECKLED DOTS AROUND FLOWER



DESIGN 11. FLORAL DESIGN

Design 10: Speckled dot design.

The tiny dots of this design give a feeling of texture. Rhythm is obtained by the repetition of dots. This can be obtained by U-foam.

Design 10a: Speckled dots around flower.

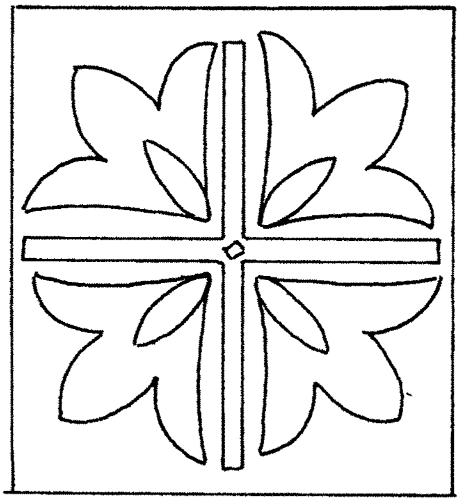
This is a variation of the design 10. This is made up of tiny dots scattered all over except in the center where an empty space in form of a four petal flower is kept to give emphasis.

Design 11: Floral design.

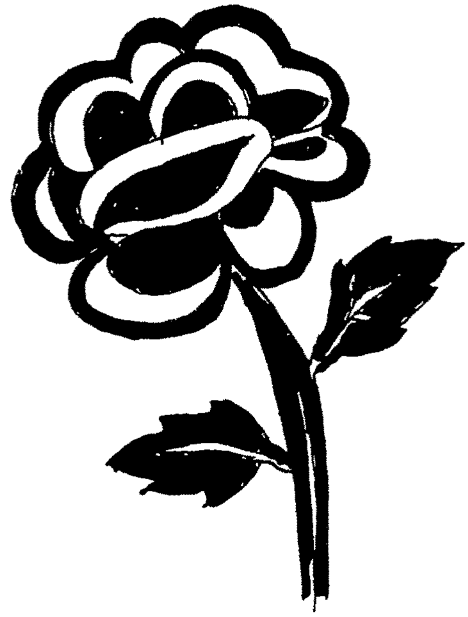
The design has its base in nature. It is a natural floral motif. The entire design is formed by curvilinear lines. Flower, leaves and stems are the units of the design. The design has an asymmetrical balance. Rhythm is created by the curved lines which give a feeling of movement. The curvilinear lines enclose the shape of flowers and leaves. Emphasis is on the flowers due to the stem which seems to move towards the flower and to end at the base of the flower.

Design 12: Cross and petal design.

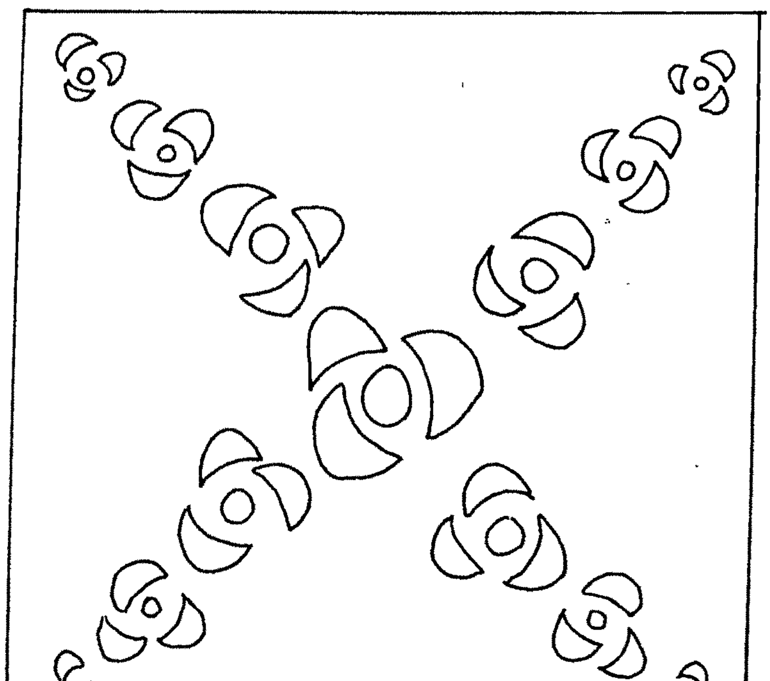
Geometric and floral units are used to create the design. The design seems to have been divide into four parts. Curvilinear lines enclose space to form the shape of three petal flower. This basic unit is repeated on all four sides. Balance



DESIGN 12. CROSS AND PETAL DESIGN



DESIGN 13. STYLIZED ROSE DESIGN



DESIGN 14. SEMI-CIRCLES SHAPES

is created by symmetry in the design. Repetition of the unit and the curved lines give rhythm to the design. Emphasis is achieved by the variation of the shapes. This design can be obtained by linoleum.

Design 13: Stylized rose design.

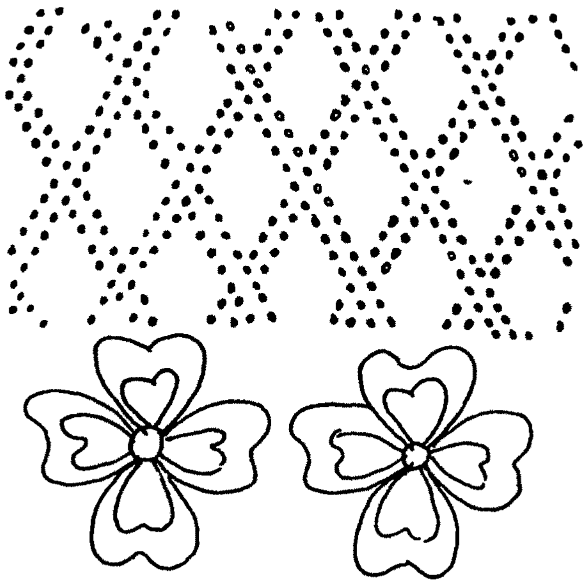
This is a natural floral motif. Curvilinear lines are used to enclose the space creating the shape of rose and petals. Rhythm is created by naturally following the outlines of flower. Rose is emphasized by the arrangement of the shapes of design around to produce symmetry.

Design 14: Semi-circle shapes.

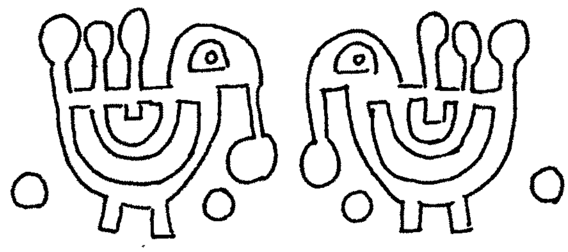
This is a stylized floral motifs in circles and curvilinear lines. Rhythm is created by the progressive change in the size of the unit as it is being repeated. The design seems to be radiating from the center towards the sides giving movement.

Design 15: Flower and diamond design.

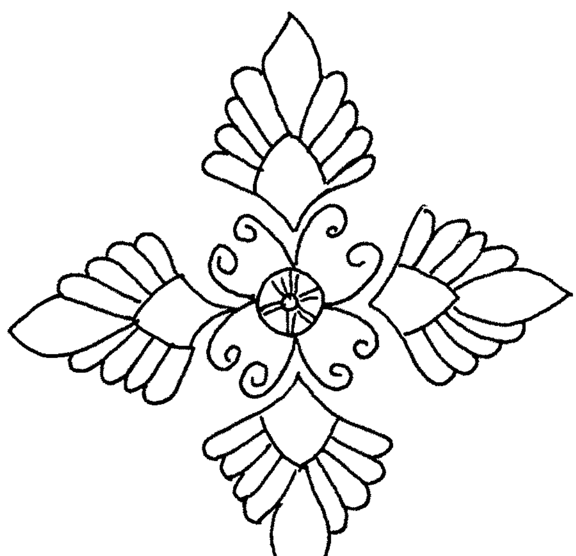
In this design geometrical and floral forms are placed side by side. The dot-lines form diamond shape. Curvilinear lines form the petals of the flowers. The flower gains emphasis in the design. This can be obtained by combining linoleum and dotted rubber for printing.



DESIGN 15. FLOWER AND DIAMOND DESIGN



DESIGN 16. STYLIZED BIRD DESIGN



DESIGN 17. STYLIZED PETAL DESIGN

DESIGN 18. LEAF AND BUD DESIGN

Design 16: Stylized bird design.

Lines and areas are utilized to get stylized forms like birds. This design has simplicity and a symmetrical balance. Can be obtained by using linoleum as printing material.

Design 17: Stylized petal design.

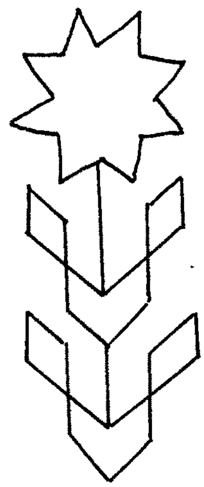
This is stylized design in the shape of a rhomboid curved lines radiating from an imaginary center towards the sides are used to form the design. Repetition of the unit give rhythm to the design. Radial symmetry creates balance in the design.

Design 18: Leaf and bud design.

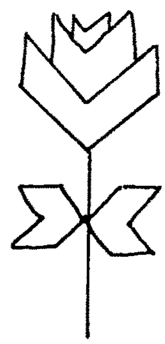
This natural motif is made by curvilinear lines. The base of the design has an illusion of heaviness due to the leaves. Rhythm is created by the repetition of the leaves. The emphasis is towards the leaves, due to its size but the steams moving towards the buds emphasize the buds. This can be obtained by linoleum.

Design 19: Geometrical flower design.

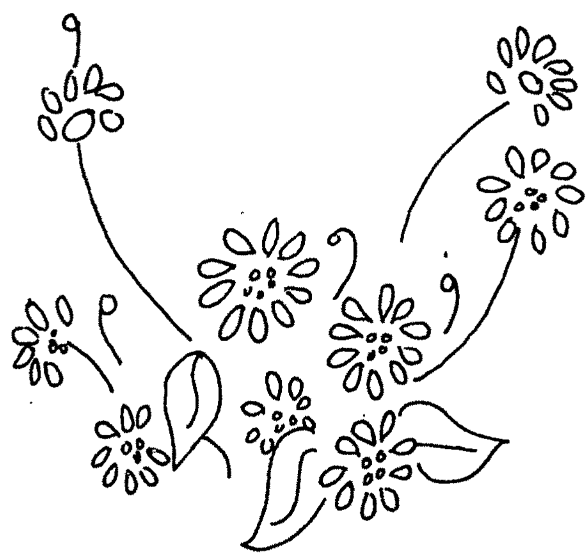
This is an geometrical design. Rectilinear lines are used to create different shapes. Short diagonal lines form the flower. Hexagons are used to form leaves. Rhythm is obtained by the repetition of the hexagon. The design has an asymmetrical balance. The flower is emphasized in the design.



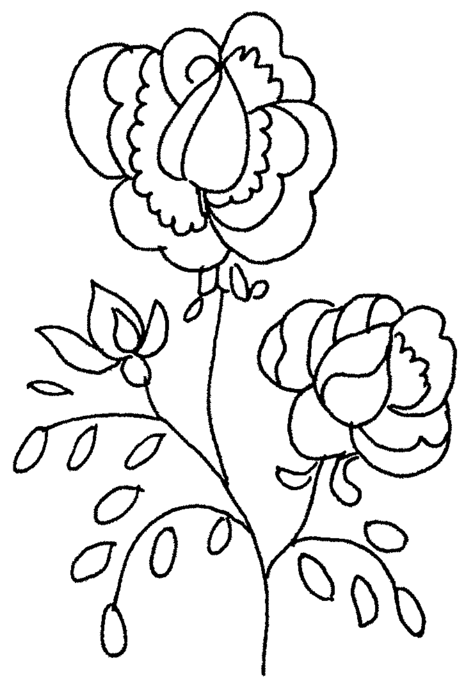
DESIGN 19. GEOMETRICAL FLOWER DESIGN



DESIGN 20. GEOMETRICAL BUD DESIGN



DESIGN 21. FLORAL DESIGN



DESIGN 22. ROSE DESIGN

Design 20: Geometrical bud design.

This is a simple geometric design. It has a flower form, stem and two leaves. Straight lines are used to create the entire design. Repetition of lines creates rhythm. It illustrates asymmetrical balance.

Design 21: Floral design.

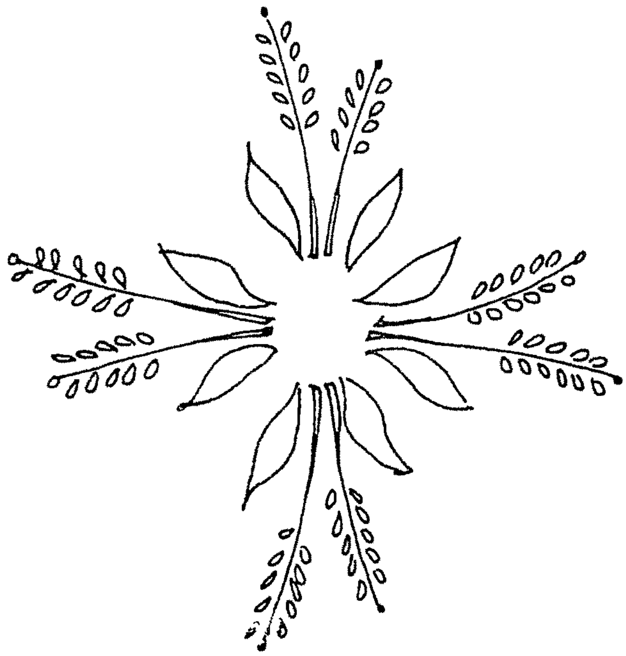
This is a natural floral design. The entire design is in a 'U'-shape. Curvilinear lines form the petals, leaves and stems. The design seems to be moving from the center towards the two upper sides. Rhythm is obtained by the repetition of the petals and flowers. The design illustrates asymmetrical balance. The emphasis in towards the base and center due to the variation in the space and number of flowers.

Design 22: Rose design.

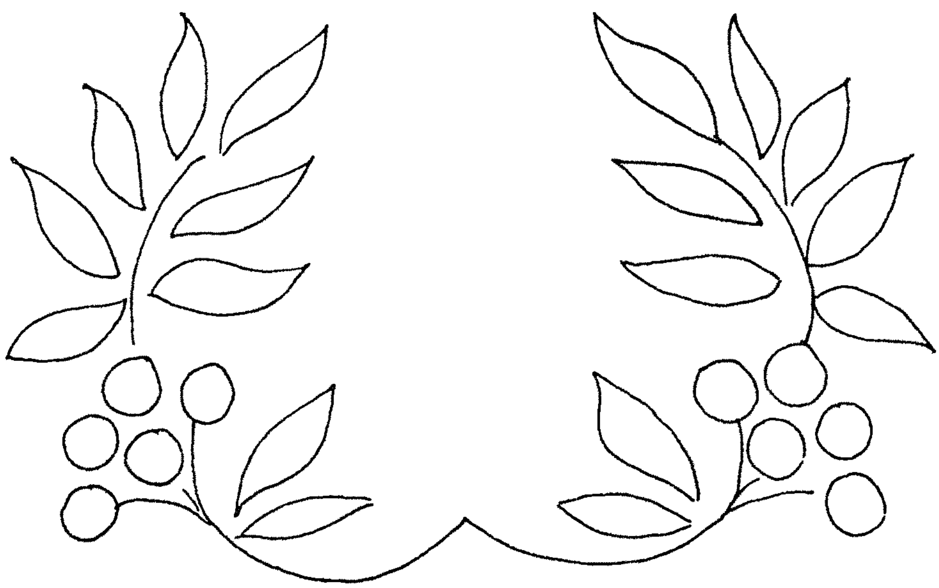
Rose and buds form this floral design, curved lines are used to form the flowers and leaves. Rhythm is created by the repetition of the rose in two size and repetition of leaves. It has asymmetrical balance. Emphasis is on the big rose flower due to the variation in size. The roses are enclosed in a circular shape.

Design 23: Leaf design.

This design taken from nature is put in a circular form. Curvilinear lines are used to form the design. Flowers,



DESIGN 23. LEAF DESIGN



DESIGN 24. LEAF & CHERRY DESIGN

leaves, stems form the design. The design radiates from the center outside. The empty space in the center creates an illusion of depth. Rhythm is created by the repetition of leaves. The design illustrates symmetrical balance. Emphasis is on the flowers formed by the repetition of small petals.

Design 24: Leaf and cherry design.

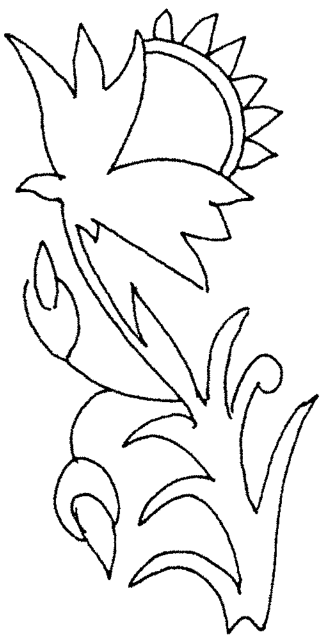
This is a natural design. The circles suggest the fruit-cherries. Leaves and fruits are used in combination. Rhythm is created by the repetition of leaves and cherries. The design has an asymmetrical balance. The design is in semi-circular form. It shows an upward direction as most of the leaves are facing upwards.

Design 25: Sun-flower design.

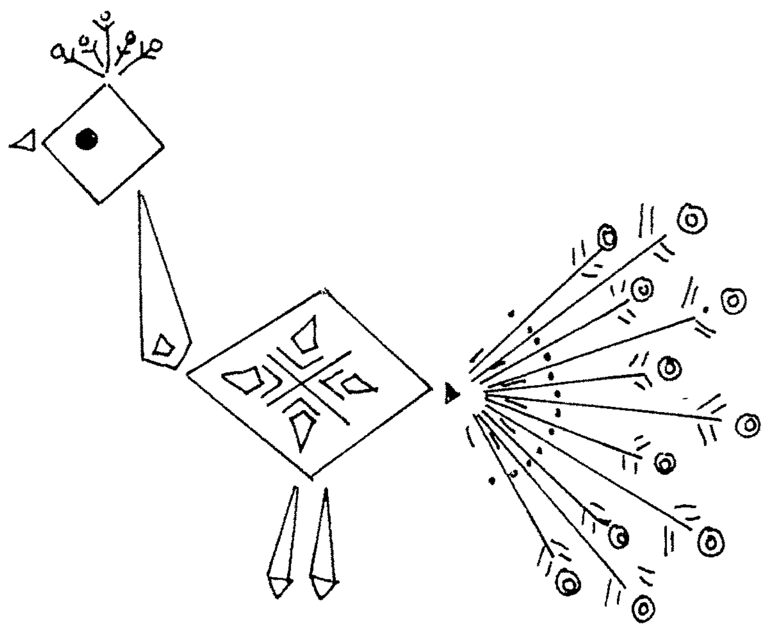
This floral design is created by curvilinear lines. Flower, buds, leaves and stem form the entire design. The repetition of the curved lines creates a movement on the surface which gives rhythm. The design illustrates asymmetrical balance. The design has an oblong form.

Design 26: Stylized peacock design.

This is a stylized peacock design made by the use of straight lines and circles. The entire design is enclosed in an rectangular form. The design has an asymmetrical balance. Rhythm is created by the diagonal lines used which



DESIGN 25. SUNFLOWER DESIGN



DESIGN 26. STYLIZED PEACOCK DESIGN

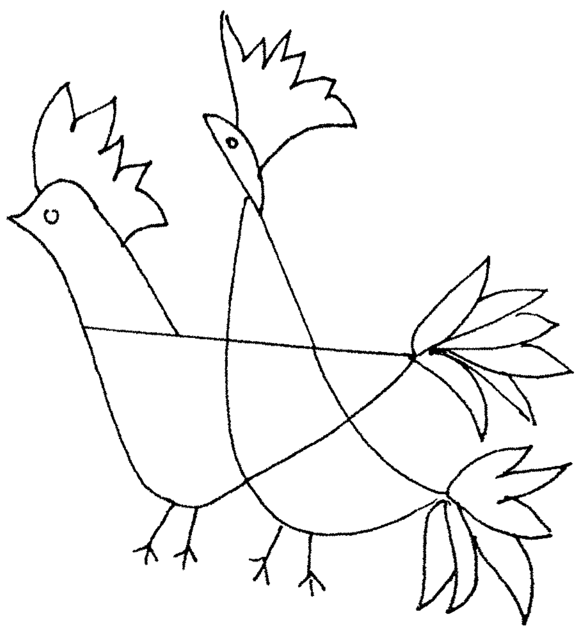


FIG. 27. STYLIZED COCK DESIGN

give a feeling of movement. The emphasis is on the feathers. The diagonal lines forming the feathers radiate from the center point outwards creating movement.

Design 27: Stylized cock design.

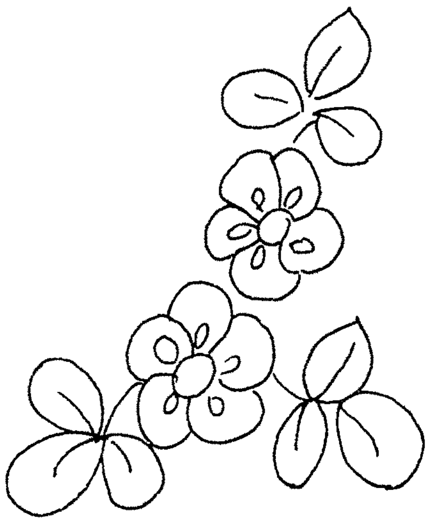
This is an stylized form of design. The bird used is cock. Rectilinear and curvilinear lines are used to form the design. The design has asymmetrical balance. The tail and head gains emphasis. Rhythm is created by the curvilinear lines which give a feeling of movement.

Design 28: Flower and leaf design.

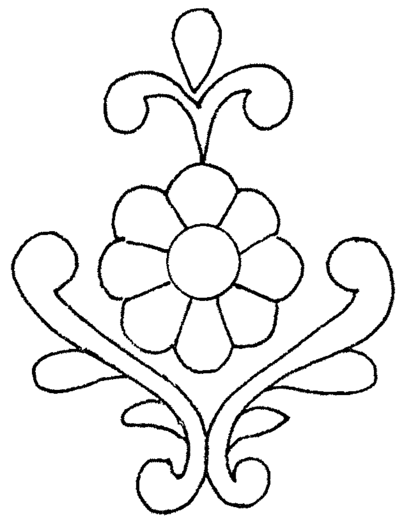
This is a natural floral design. Curvilinear lines are used to form the design. The design has flower, leaves and stem. It is in a triangular form. The design has an asymmetrical balance. Repitition of the curved lines forming flowers and leaves create rhythm in the design. The emphasis is on the flowers in the center.

Design 29: Stylized leaf and flower design.

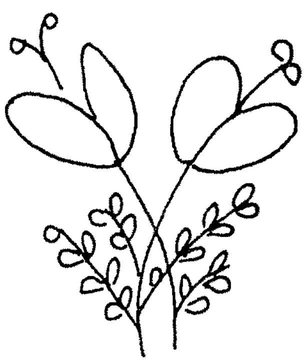
The floral design is in an oval shape. Curvilinear lines are used to form the design. Flowers and petals are used for the design. The design has an rectangular form. The rhythm is creating by the repitition of petals which form the flower. The emphasis is on the central flower created by the leaves pointed towards the center. The design has an symmetrical balance.



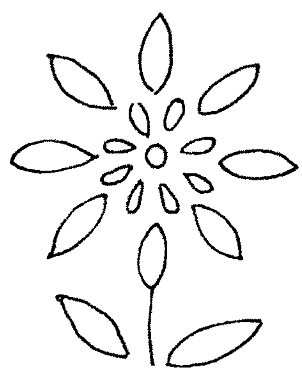
DESIGN 28. FLOWER & LEAF DESIGN



DESIGN 29. STYLIZED LEAF AND FLOWER DESIGN



DESIGN 30. FLOWER DESIGN



DESIGN 31. FLOWER WITH SCATTERED PETALS

Design 30: Flower design.

This floral design is in an triangular form. Curcilinear lines are used to form the design. Flowers leaves and stem form the design. Rhythm is created by the repetition of leaves. Asymmetrical balance is obtained. The flowers are emphasized.

Design 31: Flower with scattered petals.

This is a floral design. The form of the design is oval. Curved and straight lines are used. Rhythm is created by the repetition of petals. Balance is created by the symmetrical arrangement of petals. The flower is emphasized due to the position of the petals used.

II. Illustrations using linoleum, dotted rubber and U-foam as printing materials and discussion of effects obtained.

Illustrations were prepared with different printing materials by using some of the designs presented in Part I of this chapter. Each design illustration was prepared by block printing and transfer printing technique. Illustrations using block printing technique have been presented on fabric and paper. Another printed paper was used for preparing the transfer printing illustrations on fabric.

The effects produced by the use of these different materials have also been discussed. These illustrations are presented in the following pages and analysed.

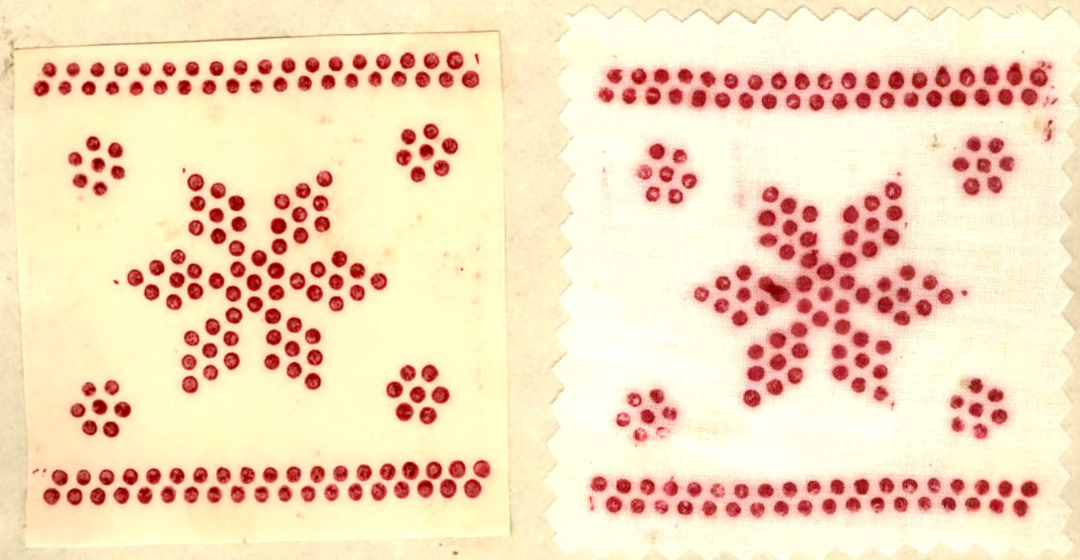
Illustration 1 and 2.

These samples were printed using dotted rubber surface. The designs here were produced by using a series of dots, to stimulate the effect of tie and dye (bandhani). The effect of the tie and dye work has been obtained by the dotted rubber as the rubber has raised dots. Besides there is ease of cutting the design. Rubber has good compressibility and the surface of dots picked up the dye paste and gave good prints.

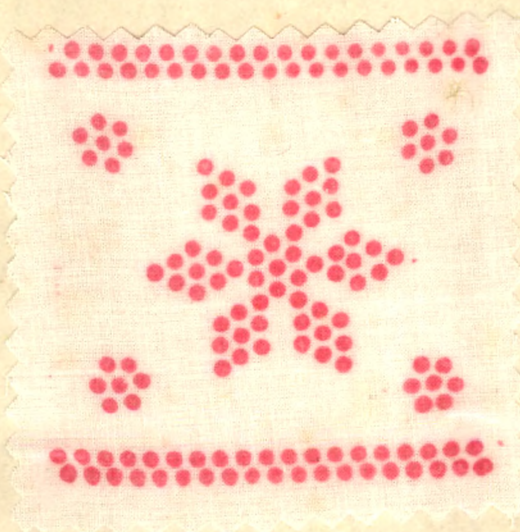
The dots in the transfer printed samples look larger. The disperse dye seems to have spread out as the dye vapours get absorbed by the facric outside the printed area of the paper.

ILLUSTRATION 1

Printing Material : Dotted Rubber



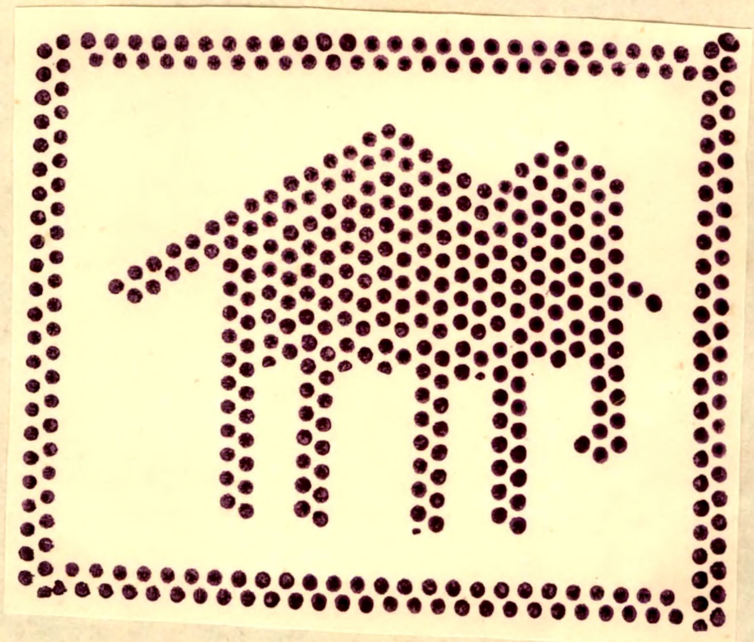
Samples Printed by Block

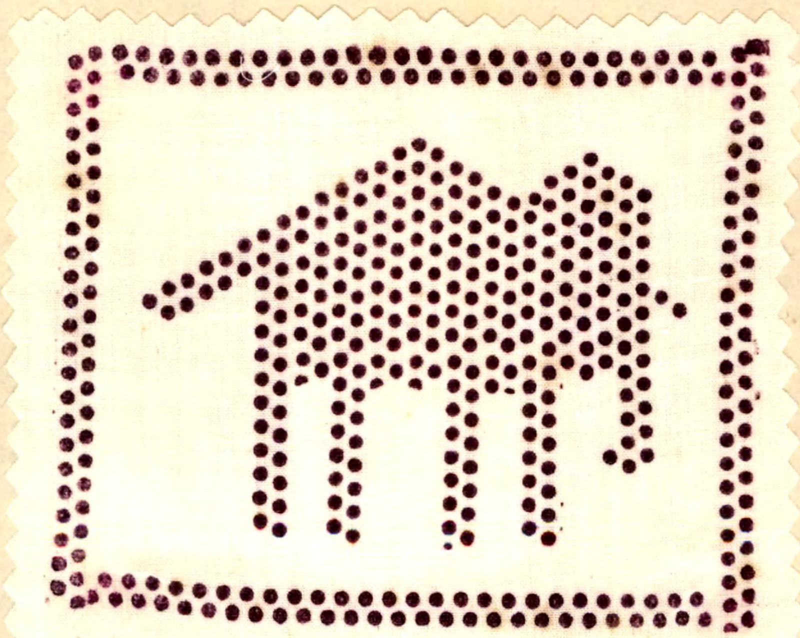


Transfer Printed Sample

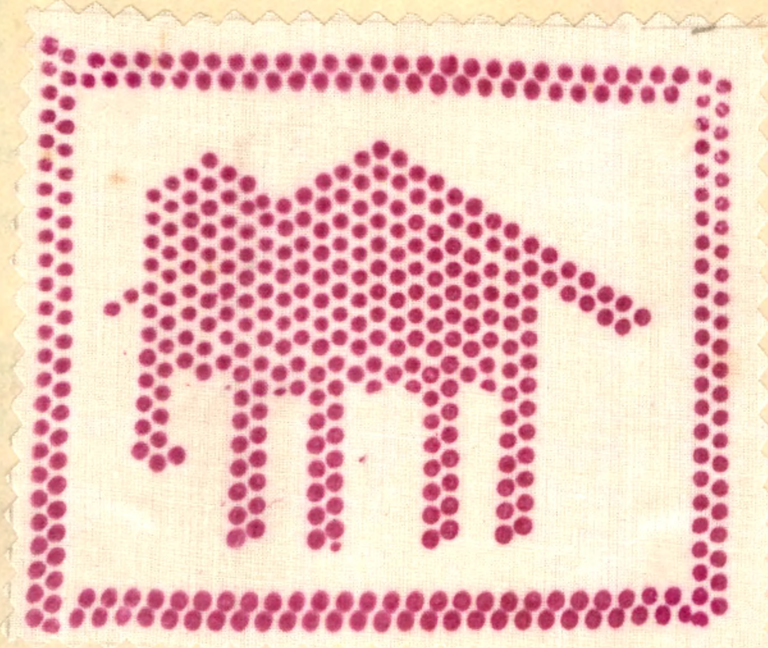
ILLUSTRATION : 2

Printing Material : Dotted Rubber





Samples Printed by Block



Transfer Printed Sample

Illustrations 3, 4 and 5.

These samples were printed by using linoleum surface in the printing block. The linoleum surface has limitations to produce even prints, however incidently this results in a textural effect in the designs. Linoleum has a smooth but little absorbant surface so it does not easily pick up the dye paste; this resulted in so called textured prints.

An effect of depth is seen in illustration 5, because of the large empty spaces, in the shape of sails.

The surface of the linoleum has to be made rough and then absorbant to obtain solid and even prints. The effect on prints of the modified linoleum surface is shown later (Illustration 9).

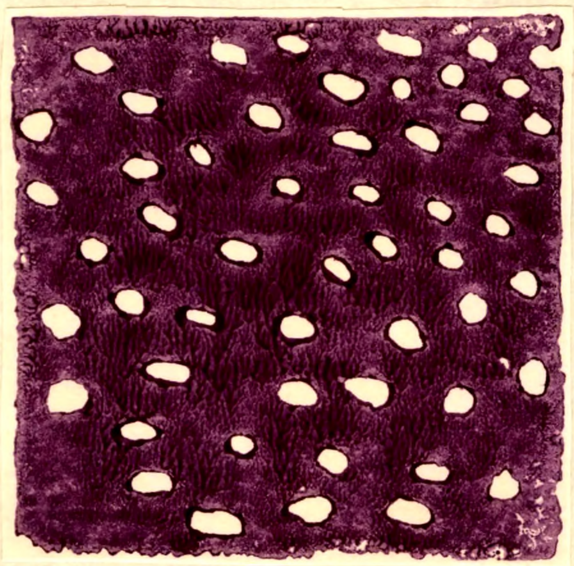
The transfer printed samples do not show any prominant textured effect; since relatively solid prints were obtained. This is because when the dye vaporizes it evens out by fabric absorption in the transfer printing. The effect of depth in illustration 5 is seen better in the transfer printed sample.

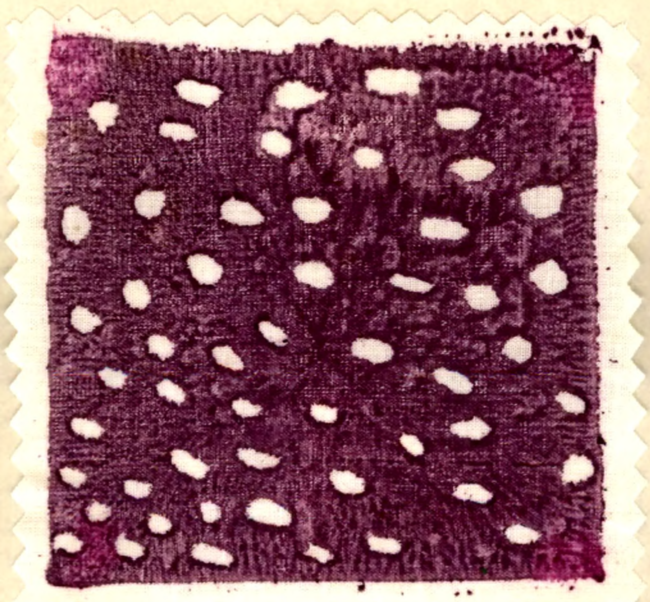
Illustrations 6 and 7.

U-foam as the printing material gives a speckled effect. The effect obtained is similar to that of spray printing. U-foam is a highly compressible and absorbant material and the surface is in relief as well as in entanglio. Due to the absorbancy of the U-foam it picks up the dye paste when pressed

ILLUSTRATION : 3

Printing Material : Linoleum



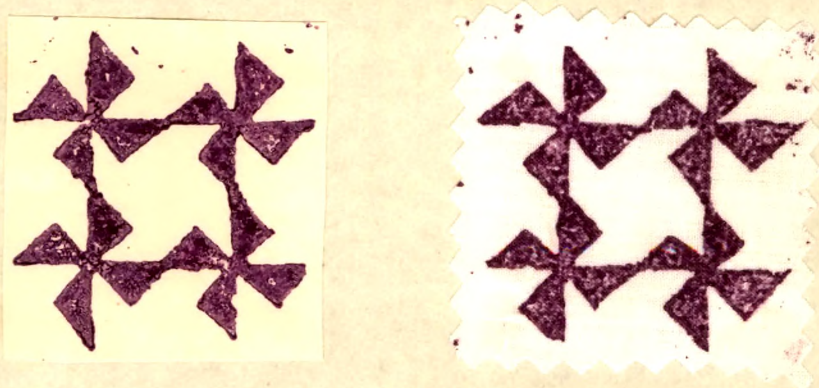


Block Printed Samples

Transfer Printed Sample

ILLUSTRATION : 4

Printing Material : Linoleum



Samples Printed by Block

Transfer Printed Sample

ILLUSTRATION : 5

Printing Material : Linoleum

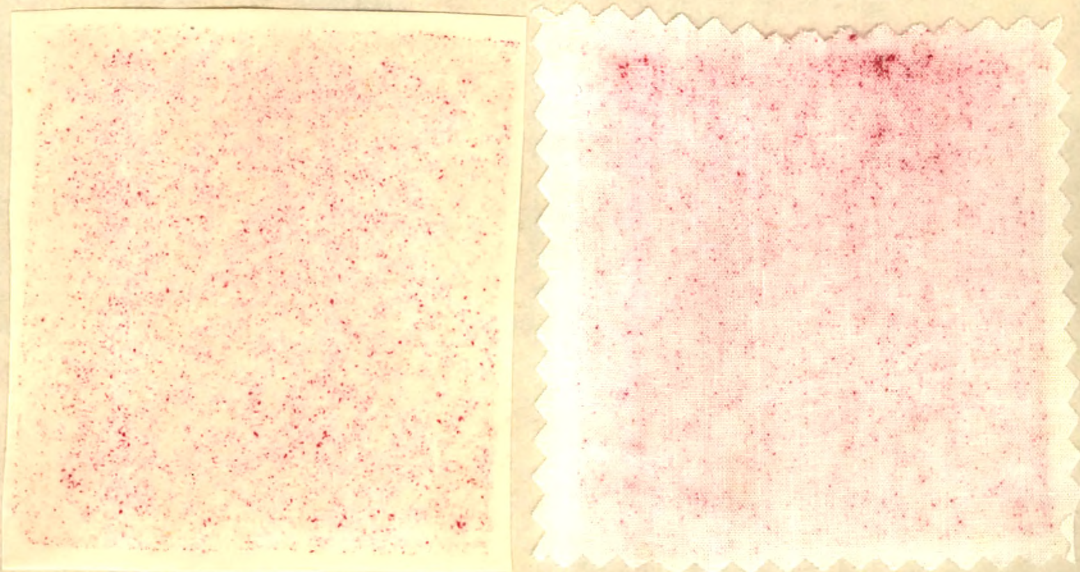
Sample Printed by Block

Sample Printed by Block

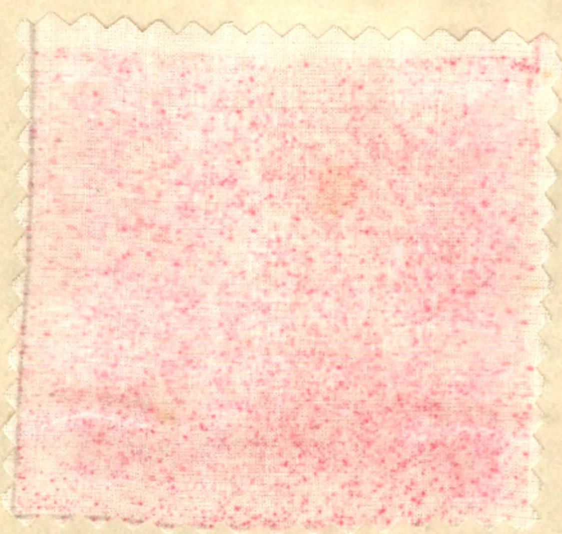
Transfer Printed Sample

ILLUSTRATION : 6

Printing Material : U-Foam



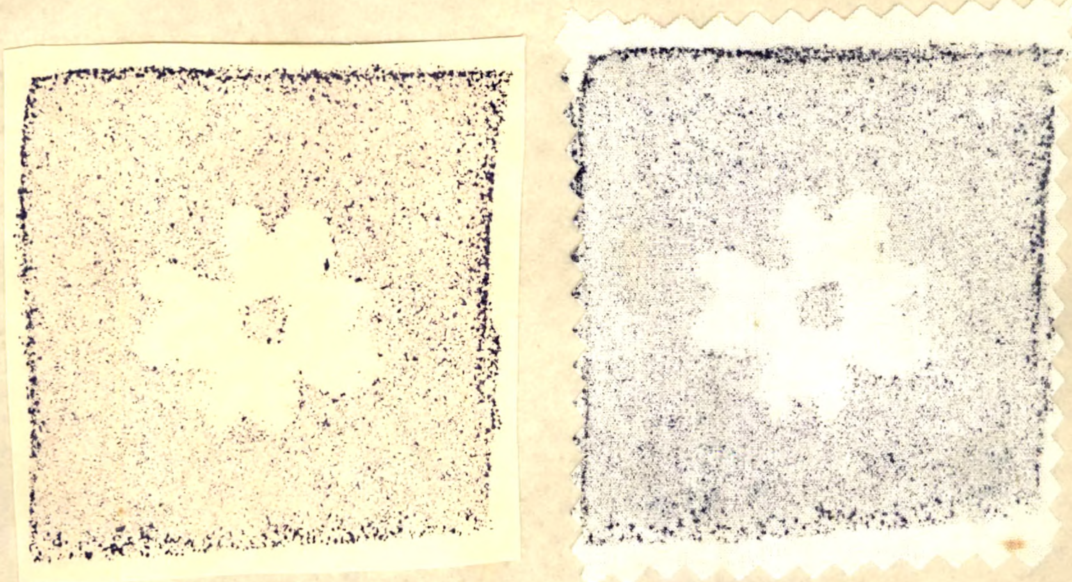
Samples Printed by Block



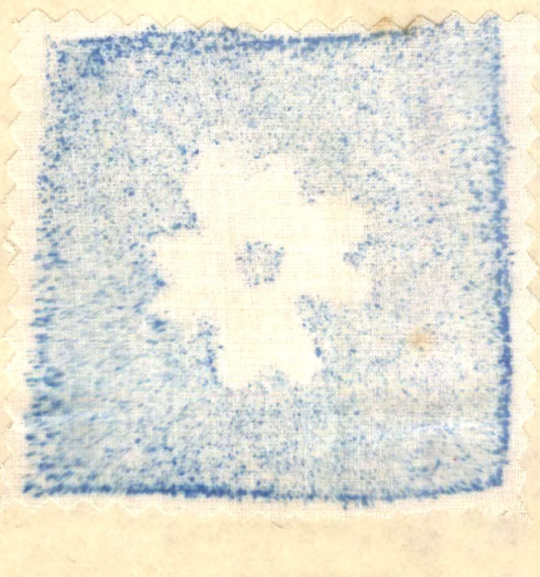
Transfer Printed Sample

ILLUSTRATION : 7

Printing Material : U-Foam



Samples Printed by Block



Transfer Printed Sample

onto the dye paste pad. Thus the U-foam will have dye on the raised portions and into the depressed/hollow surface. While printing, the pressure to be applied is less, so that dye paste from the raised surface gets absorbed by the fabrics. Thus giving a speckled effect. If more pressure is applied, the dye paste will come out even from the depressed surface and the speckled effect will not be seen.

The speckled effect is also seen in the transfer printed samples.

Illustrations 8, 9 and 10.

Here the printing material used is linoleum. As discussed earlier linoleum gives an uneven and textural effect in printing as seen in illustrations, 8, 9a, and 10.

The surface of the linoleum was modified to get solid even printing. This is seen in illustration 9b. The surface was made rough and modified by flocking with cellulose powder, which made the surface absorbant giving solid even prints.

In illustration 9c a tone effect is obtained by using unmodified and modified surface of linoleum. The unmodified surface gave an uneven print which had less colour depth while the modified surface gave prints having more colour depth thus showing a two-tone effect in the design.

The transfer printed samples show similar effects.

ILLUSTRATION : 8

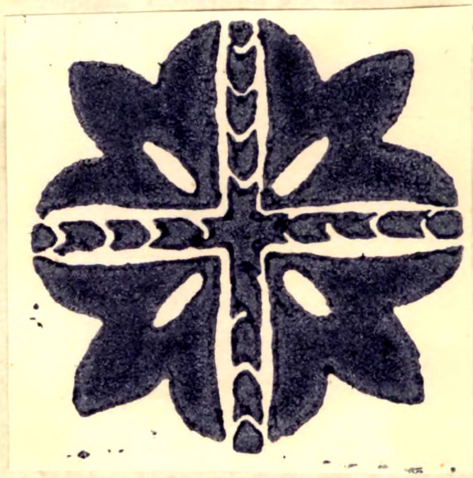
Printing Material : Linoleum

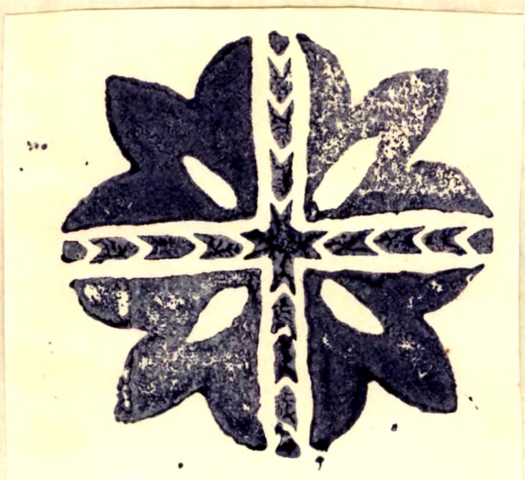
Samples Printed by Block

Transfer Printed Sample

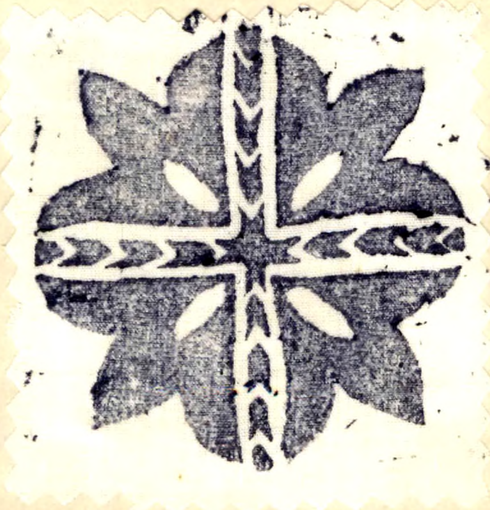
ILLUSTRATION : 9
Printing Material : Linoleum


9a

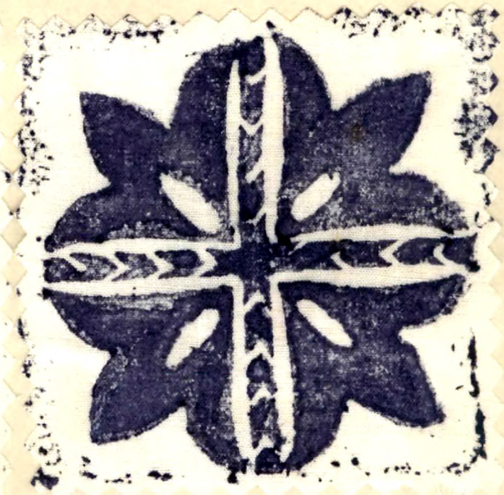

9b


9c

Samples Printed by Block



9a



9b

9c

Samples Printed by Block

9a 9b

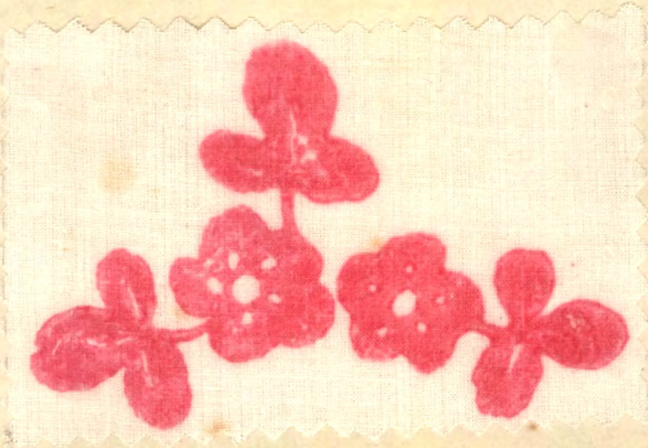
9c

Transfer Printed Samples

ILLUSTRATION : 10

Printing Material : Linoleum

Samples Printed by Block



Transfer Printed Sample

Illustration 11.

In this two different printing materials, dotted rubber and linoleum are used together. The effect obtained is same as when the two materials are used separately because the compressibility of both the materials was similar. However there were small differences in surface, which gave a tone effect as dots gave solid print while the flower in linoleum gave textural effect. The tone effect was better in illustration 9c, when unmodified and modified linoleum were used together. This is because with modification the absorption characteristic of the surface changed, resulting in better two tone effect.

Illustrations 12a and 12b.

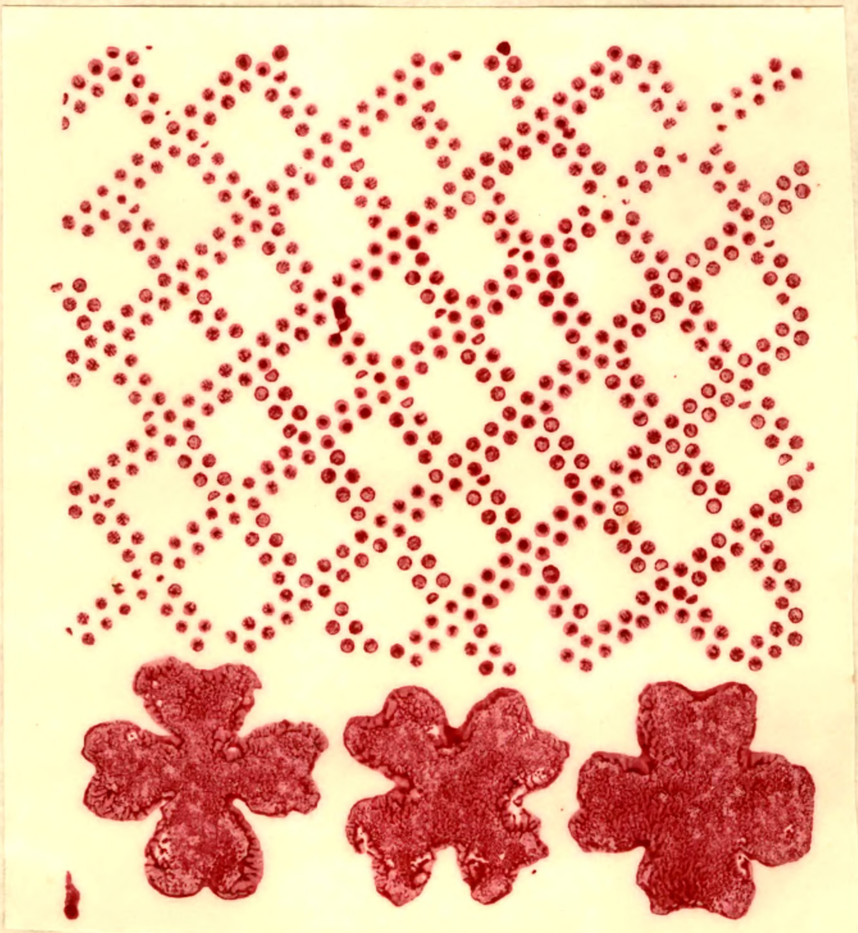
U-foam was used here for background printing. The design was obtained by dotted rubber in illustration 12a, and in illustration 12b linoleum was used.

Both the illustrations showed pleasing effect in the block printed and transfer printed samples as a contrast of texture of the background and actual design is obtained.

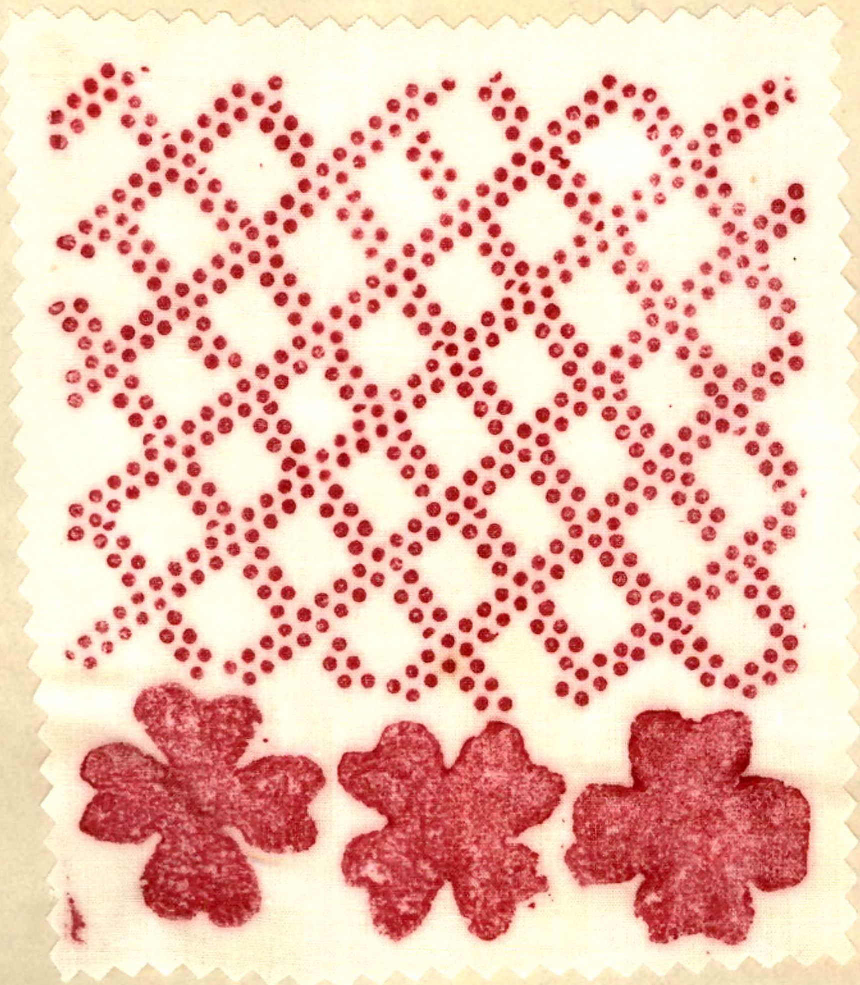
Combination designs with linoleum and dotted rubber can be obtained by using both the materials together on one block as both require impact for printing; whereas when combination of linoleum or dotted rubber has to be made with U-foam, two separate blocks are required as printing with U-foam blocks

ILLUSTRATION : 11

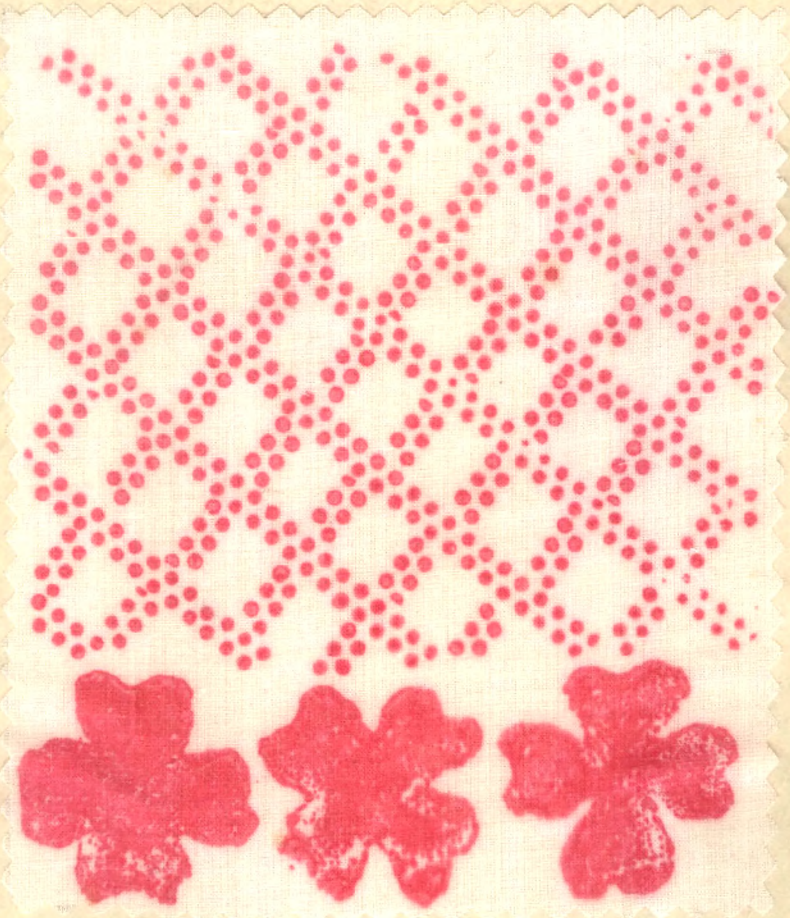
Printing Materials : Dotted
Rubber and Linoleum



Sample Printed by Block



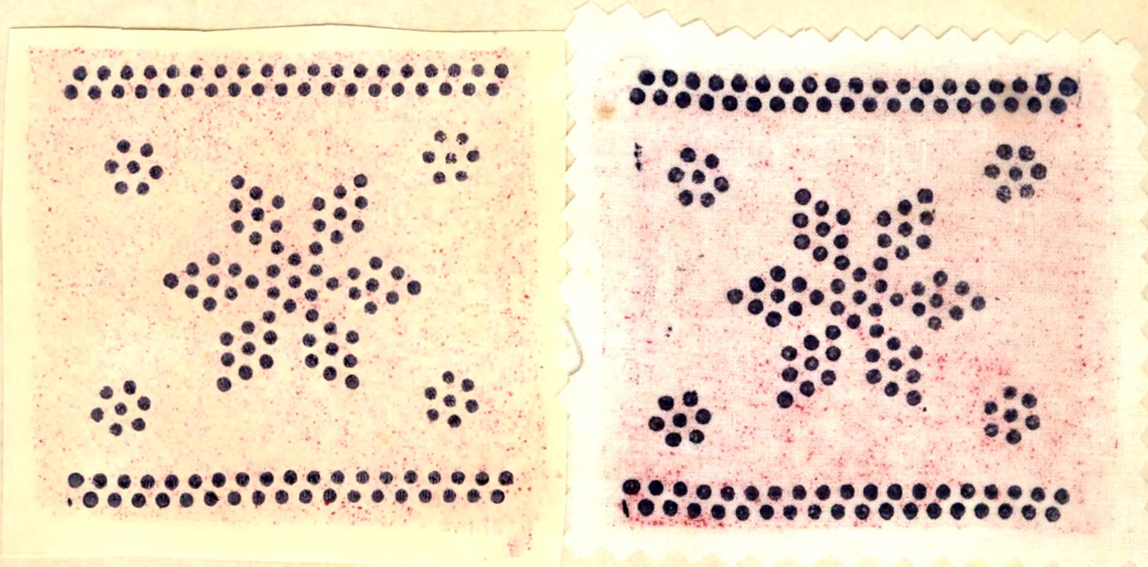
Sample Printed by Block



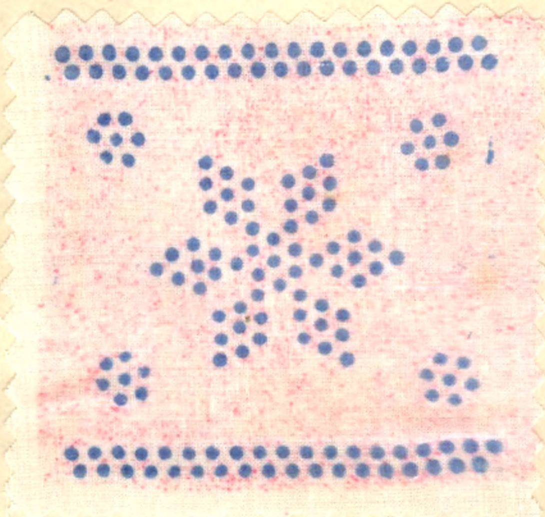
Transfer Printed Sample

ILLUSTRATION : 12a

Printing Materials : U-Foam and Dotted Rubber



Samples Printed by Block



Transfer Printed Sample

ILLUSTRATION : 12b

Printing Material : U-Foam and Linoleum

Samples Printed by Block

Transfer Printed Sample

require compression and linoleum or dotted rubber would need impact.

These illustrations (1 to 12) show the different effects obtained by using different printing materials. Such effects have also been reported by Desai (10) in her study. She has reported that modified linoleum surface gives even prints. In her study linoleum and dotted rubber gave good effect in printing but unlike this study she reported that U-foam could not give pleasing effect. U-foam being a highly compressible material require much more practise than linoleum printing to get satisfactory results. While inking more compression has to be used so that enough dye gets absorbed. While printing the compression should be less, so that if the dye paste is not absorbed evenly by the U-foam while inking, the dye paste which comes out on the fabric surface while printing is even.

Table 1. Preliminary data of fabrics.

Fabric code	Fiber content	Fabric count Yarns/inch (Yarns/cms)		Wt.per unit area (Oz/sq. yd.) (gm/sq.mt.)	Thickness in inch (in cm)
		Warp	Weft		
A	100% COT	104.0	32.4	2.07	.0025
		(41.6)	(81.0)	(72.8)	(.0062)
B	50% PE 50% COT	76.0	22.6	2.62	.0036
		(30.4)	(56.5)	(92.0)	(.009)
C	67% PE 33% COT	92.5	32.2	2.11	.002
		(37.0)	(80.5)	(74.0)	(.005)
D	100% PE	110	37	2.37	.0024
		(44)	(92.5)	(85.4)	(.006)

COT = Cotton

PE = Polyester

The preliminary fabric data on fiber content fabric count weight per unit area and thickness have been given in Table 1. The fabric constructions fell into two general classes. Fabrics A, C, D were of relatively tight constructions, while fabric B was of relatively loose construction. All the fabrics were of medium weight. The thickness of the fabrics was also similar.

III. Results of the application of transfer printing as an experimental technique.

The transfer printing process is based on the sublimation ability of the disperse dye and the polyester fabric is receptive to the vapours of this dye. In this part of the study the technique of transfer printing has been used as an experimental technique using (a) fabric other then polyester i.e. cotton and its blends with polyester, (b) using synthetic polymer emulsions as a finish on the fabrics prior to transfer printing and (c) using synthetic polymer emulsion along with disperse dye in the printing paste.

Application of transfer printing on small scale can be enhanced by finding out similar process for its application on cotton as well as polyester cotton blends.

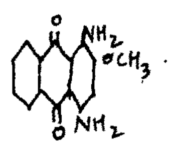
Printing of textiles by transfer printing technique is simple and can be used on a small scale as very simple equipments are required which do not need large space. After treatment such as washing which is required for fabrics printed by other techniques are not required here. No special skill is required for this technique. This technique is very useful for obtaining designs on specific areas of a garment, after cutting the garment. It can be a substitute for the patch work, embroidery and other decorations used on children's garments, handkerchiefs and dinner napkins, table mats, etc.

The study was thus aimed to find out whether applications of transfer printing can be enlarged. Since transfer printing depends on vaporizing ability of disperse dye, it was thought to improve this by incorporating a synthetic polymer emulsion both as a finish as well as in the printing paste. The transfer printing ability of a disperse dye which is indirectly given as sublimation fastness, has been varied by modifying the conditions which affect heat redistribution/diffusion. The three dyes used had varying sublimation fastness.

Dye code	Name of the dye	CI No.	Sublimation fastness (contact time 30 sec.) 180°C	210°C
I	Vernasol violet 6R	Disp. Red 11	2-3	1
II	Resolin blue I-FBL	Disp. Blue 56	3	2
III	Navilene scarlet RR	Disp. Red 54	4-5	3

The chemical constitutions of these dyes have been given below.

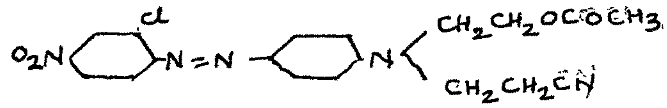
Dye I : Vernasol violet 6R



Dye II : Resolin blue I-FBL

Constitution not available.

Dye III : Navilene scarlet RR



The four fabrics used were cotton 100 percent, polyester: cotton (50:50), polyester:cotton (67:33) and polyester 100 percent. Three synthetic polymer emulsions were used namely: (1) Acrylic emulsion*, (b) Polyvinyl acetate**, (c) Polyvinyl alcohol*.

The results of the experiments are given in the following pages.

Transfer printing abilities by the three disperse dyes, Dye I, II and III on the fabrics were studied under different conditions.

The following three variations were studied and the results of these are presented:

a. Synthetic polymer emulsion used as a finish on the fabric.

b. Synthetic polymer emulsion used in the printing paste composition.

c. Different combinations of the above two variations.

Transfer printing of samples was done using the variations mentioned and the effects from these variations were then

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*Manufactured by Ahura Chemical Products Pvt. Ltd., 84-Sion Road, Sion East, Bombay 400 022.

**Manufactured by Texchem, 132, Dr. Annie Besant Road, Bombay 400 018.

compared and explained from their application point of view. The results are discussed in the following pages as follows:

(A) <u>Results and Discussion for Dye I : Vernasol Violet 6R</u>.

i. The influence of varying finishes on the fabrics on the transfer printing ability.

ii. The influence of varying synthetic polymer emulsions in the paste on the transfer printing ability for different fabrics.

iii. The influence of finish on fabric and synthetic polymer emulsion in paste in combination.

1. <u>The influence of varying finishes on the fabrics on the transfer printing ability</u>.

The fabric samples used were unfinished and finished with all the three synthetic polymer emulsion and their relative transfer printing abilities were compared. The data regarding these is given in Table 2 and presented graphically in Figure 1.

Table 2. Data on the relative transfer printing number of different fabrics at varying finish treatments.

Fabric code	% Fiber content		Relative transfer printing numbers			
	PE	COT	Fo/Po	F1/Po	F2/Po	F3/Po
A	-	100	2	7	9	3
B	50	50	5	8	9.5	8
C	67	33	9	9.5	10	9
D	100	-	10	10	10	10

PE : Polyester.

COT : Cotton

Fo : Unfinished

F1 : Finished with Acrylic emulsion.

F2 : Finished with Polyvinyl acetate.

F3 : Finished with Polyvinyl alcohol.

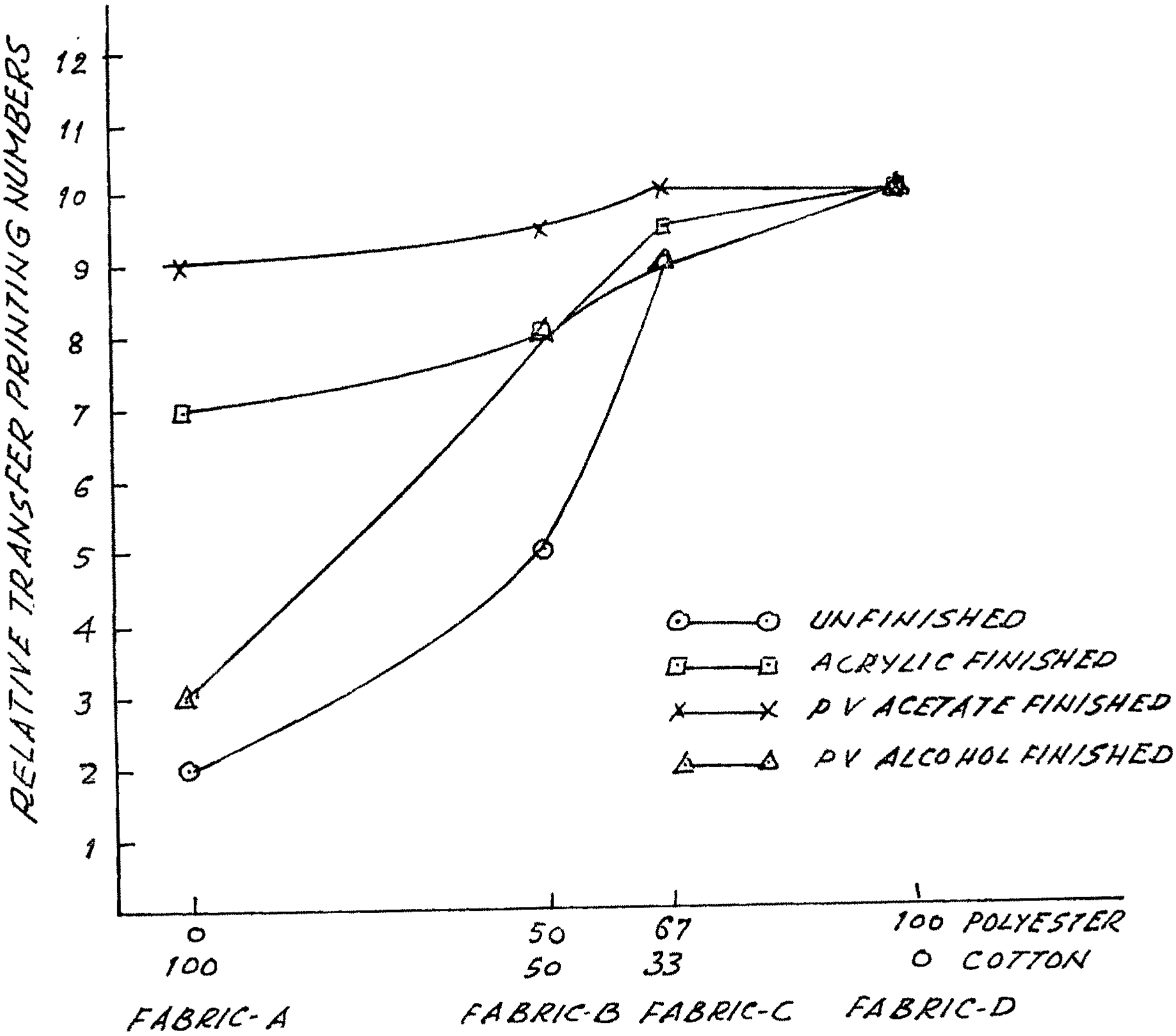
Po : Paste without synthetic polymer emulsion.

Transfer printed samples on pages 119-122, 128-131

All the unfinished fabrics showed lower transfer printing ability than the finished fabrics. 100 percent cotton fabrics showed very low transfer printing ability but the blends of polyester:cotton (specially 67:33 P:C) showed good transfer printing ability.

The transfer printing ability was positively influenced by the finishes though differently. The film forming polyvinyl alcohol finish (F3) had least influence specially with cotton fabric A. Treated fabrics of 100 percent cotton and its blends

FIG. 1 INFLUENCE OF VARYING FINISHES IN FABRICS ON TRANSFER PRINTING ABILITY OF DYE-I FOR DIFFERENT FABRICS



with polyester (50P:50C and 67P:33C) showed more transfer printing ability than the corresponding untreated fabrics. The influence of the treatment to increase the transfer printing decreased with the increase of polyester content. The untreated and treated 100 percent polyester fabrics moreover had the same transfer printing ability indicating no influence of the treatment in polyester fabrics.

The synthetic polymer emulsion influenced cotton and its blends with polyester but did not influence the 100 percent polyester has also been reported by Phadke (25) in her study on some physical properties of these fabrics. Acrylic finish (T x 50) used in her study increased the appearance ratings of cotton and blends. This was equated by her as ease of ironing due to the thermoplastic nature.

The influence towards transfer printing of the presence of polymer finishes and the polyester fiber itself are observed to be similar. Polymer finish improved the transfer printing of cotton whether alone or in blend. The substrate was thus influenced for its receptivity of dye.

The influence of thermosetting resin finish on cotton and its blends for improving the transfer printability was also reported by Blanchard (5) and by Weiland and Robin (34). In Situ polymerization of acrylic acid, acrylamide and their mixtures onto polyester-viscose blends and improved transfer printing with disperse dyes on such modified fabrics was reported by Despande and Chavan (11).

Other studies have reported a similar influence on the improvement of transfer printing by various pretreatments- (a) Padhye and Gupta (24) treated the fabrics with alkali followed by a swelling agent Hicotol CAR, (b) Weiland and Robin (34) used N-methylol carbomates plus polyethylene glycol and a cross-linking latex for the treatment, (c) Nishida et al. (23) treated the fabrics with Acetic acid, propionic acid and Butyric acid which improved the transfer printability, (d) Achwal and Deshmukh (1) treated the fabrics with swelling agents and cross linking agents to get improved transfer printability.

This study also showed the positive influence of pre-treatment by finishing agents on the transfer printability of fabrics. The finishing agents used were thermoplastic by nature and this property helped in improving the transfer printability. The vapours of disperse dyes are receptive to the polyester fabric which has thermoplasticity. The finishes imparted this thermoplastic nature to the non-thermoplastic fiber cotton and made it receptive to the vapours of the disperse dye and thus improved the transfer printability.

The finishes used did not help to increase the transfer printability of 100 percent polyester fabrics because 100 percent polyester fabric being thermoplastic in nature is receptive to the disperse dye so even when unfinished it would have absorbed the maximum dye possible soothe application of the finish could not have increased the amount of dye transferred, thus the transfer printability remained unchanged.

To improve the transfer printability of 100 percent polyester synthetic polymer emulsion were incorporated in the normal printing paste. The effect on 100 percent cotton and blends (50:50 and 67:33) with polyester was also seen. The results are discussed in the following section (ii).

ii. <u>The influence of varying synthetic polymer emulsions in paste on the transfer printing ability for different fabrics</u>.

In this section the fabric samples used were unfinished while the synthetic polymer emulsion was incorporated in the normal printing paste. The relative transfer printing ability of fabrics samples printed with normal paste was compared with the fabric samples printed with paste containing synthetic polymer emulsions. The data is presented in Table 3 and shown graphically in Figure 2.

Table 3. Data on the relative transfer printing number of different fabrics printed with varying synthetic polymer emulsions in the paste.

Fabric code	% Fiber content		Relative transfer printing numbers			
	PE	COT	Po/Fo	P1/Fo	P2/Fo	P3/Fo
A	-	100	2	2.5	4.0	6
B	50	50	5	6	9	10
C	67	33	9	10	12	10
D	100	-	10	20	20	>20

PE : Polyester.

COT : Cotton.

Po : Paste without synthetic polymer emulsion.

P1 : Polyvinyl acrylic emulsion in paste.

P2 : Polyvinyl acetate in paste.

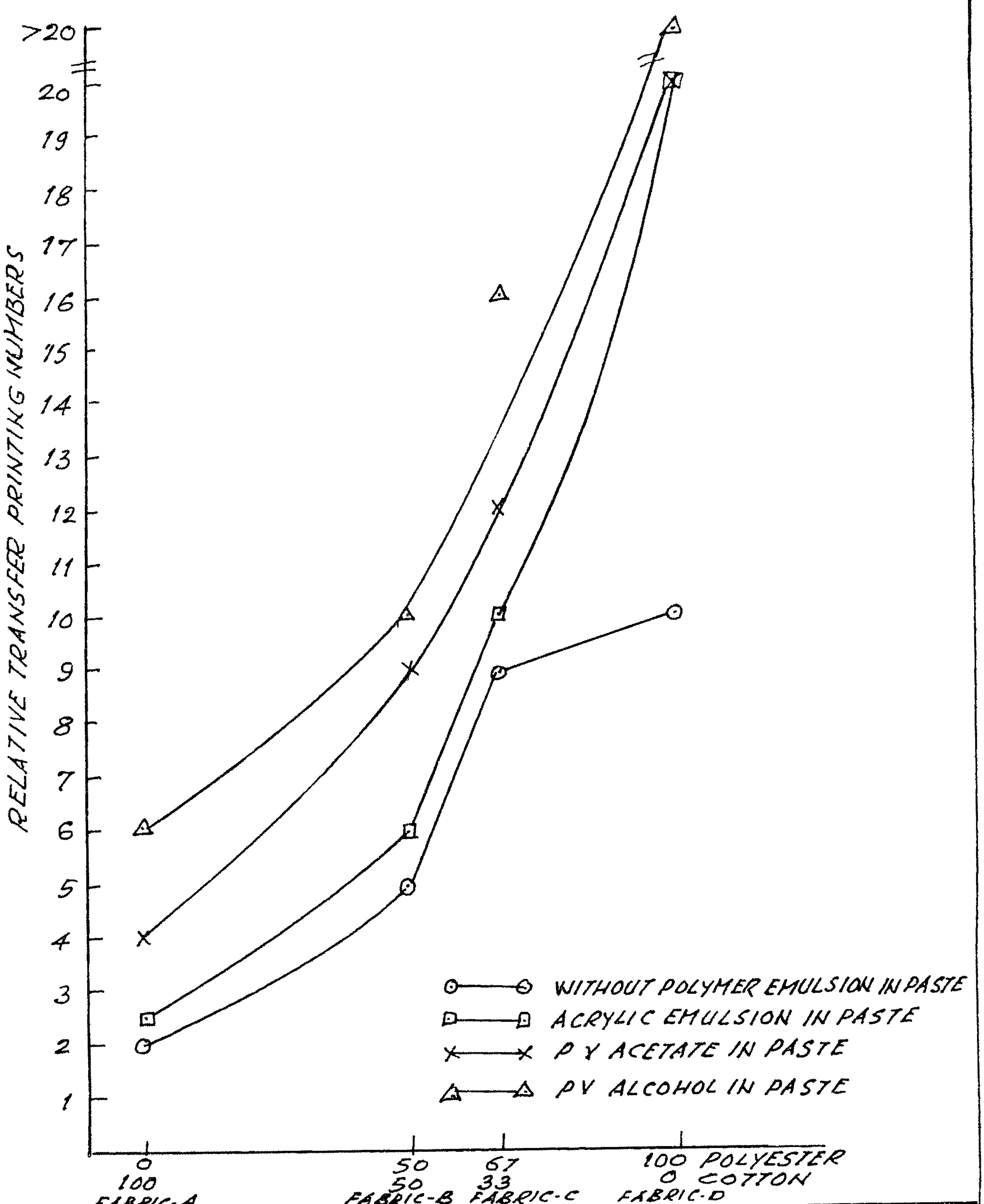
P3 : Polyvinyl alcohol in paste.

Fo : Unfinished.

Transfer printed samples on pages 119-122

A broad comparison of these results (Table 3) with those in Table 2 indicated that the influence of the polymer emulsions in the printing paste to increased the transfer printability for all the fabrics which was not so in Table 2, where 100 percent polyester fabric did not show an increase in transfer printability after polymer emulsion finishes were applied on the fabric. Thus 100 percent polyester fabric is not an exception here (as noted earlier in Table 2).

FIG. 2 INFLUENCE OF VARYING SYNTHETIC POLYMER EMULSIONS IN PASTE ON THE TRANSFER PRINTING ABILITY OF DYE-I FOR DIFFERENT FABRICS



The relative transfer printability of all the fabrics increased when printed with pastes containing polymer emulsions. The influence in 100 percent cotton was a less than in 100 percent polyester and blends showed intermediate influence for increasing transfer printability.

The ability of the synthetic polymer emulsion in the paste to increase the transfer printing also improved with increase in the polyester content of the fabric. Pastes containing polyvinyl alcohol and polyvinyl acetate showed more ability to increase the transfer printing than paste containing acrylic emulsion.

The increased transfer printability in all the fabrics when printed with pastes containing polymer emulsions could have been due to the thermoplastic nature of the polymer emulsions which developed a better contact between the fabric and the paper. Due to the presence of the polymer emulsions in the paste better diffusion of heat must have taken place resulting in increased vapour pressure which in turn gave better transfer printability than the normal paste.

The results from Table 2 and Table 3 when compared showed that for 100 percent cotton fabric samples the use of synthetic polymer emulsion as a finish gave better transfer printability than when it was incorporated in the printing paste whereas for 100 percent polyester opposite trend was noticed.

The synthetic polymer emulsion when used as a finish for 100 percent polyester did not improve the transfer printability but when it was incorporated in the normal printing paste it showed increased transfer printability.

From the results of (i) and (ii) the following conclusions were drawn:

a. 100 percent cotton fabric has to be made receptive to the vapours of disperse dye for obtaining transfer printability by finishing with a synthetic polymer emulsion.

b. 100 percent polyester fabric is as much receptive to the disperse dye so to get increased transfer printability the synthetic polymer emulsion should be incorporated in the printing paste.

c. Fabrics which are blend of cotton and polyester if made receptive by applying polymer emulsion as a finish and then printing with pastes containing polymer emulsion would increase their transfer printability.

d. Fabrics containing cotton if first finished with polymer emulsion and then printed with paste containing polymer emulsion would increase their transfer printability.

Thus to find out the effect of the combined use of synthetic polymer emulsions as a finish and in the paste various finish/paste combinations were tried, the results of which have been given in this sub-section (iii).

TRANSFER PRINTED SAMPLES
OF COTTON FABRICS UNFINISHED (Fo) - DYE I

P_0

P_1

P_2

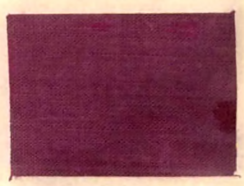
P_3

TRANSFER PRINTED SAMPLES
OF COTTON FABRICS FINISHED WITH ACRYLIC
EMULSION (F1) - DYE I

P_0

P_1

P_2



P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS UNFINISHED
(Fo) - DYE I

P_0

P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS FINISHED
WITH ACRYLIC EMULSION (F1) - DYE I

P_0

P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS UNFINISHED
(Fo) - DYE I

P_0

P_1

P_2

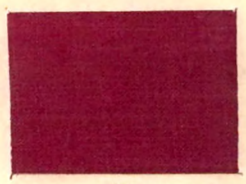
P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS FINISHED
WITH ACRYLIC EMULSION (F1) - DYE I

P_0

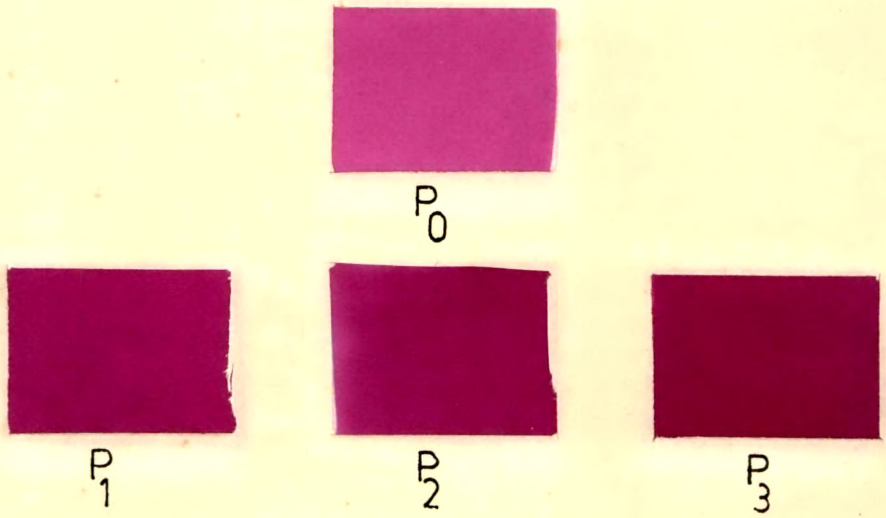
P_1

P_2

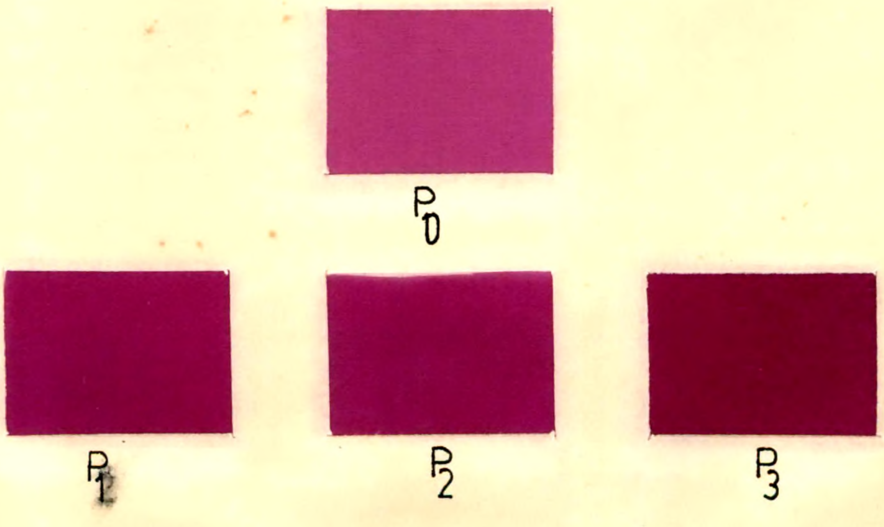


P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS UNFINISHED (Fo) - DYE I



TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS FINISHED WITH
ACRYLIC EMULSION (F1) - DYE I



iii. The influence of the combined use of synthetic polymer emulsion as a finish and in the paste on the transfer printing ability of different fabrics.

The data on the transfer printing ability by the combined use of each of the three synthetic polymer emulsion as a finish and in the paste on the transfer printing ability of different fabrics has been given in Tables 4 to 6 and presented graphically in Figures 3 to 5.

(a) The data in Table 4 and Figure 3 is for the fabrics finished with acrylic emulsion and printed with three different pastes each containing one polymer emulsion and with a paste without synthetic polymer emulsion.

The comparison of the data on the finished fabrics printed with paste without any synthetic polymer emulsion and with pastes containing synthetic polymer emulsions showed that the transfer printability of all the fabrics increased when printed with pastes containing polymer emulsion. 100 percent cotton fabric finished with acrylic emulsion and printed with paste containing polyvinyl alcohol showed more transfer printability than 100 percent polyester fabric finished with acrylic emulsion and printed with paste not containing a synthetic polymer emulsion. Such result for 100 percent cotton was obtained because the fabric was first made receptive to the disperse dye and was then printed with a paste containing a polymer emulsion.

Table 4. Data on relative transfer printing number of fabrics finished by acrylic emulsion having varying fiber content printed with varying contents in paste.

Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Po/F1	P1/F1	P2/F1	P3/F1
A	-	100	7	9	11	13
B	50	50	8	13	14	16
C	67	33	9.5	14	16	18
D	100	-	10	20	20	>20

PE : Polyester

COT : Cotton

Po : Paste without synthetic polymer emulsion.

P1 : Acrylic emulsion in paste.

P2 : Polyvinyl acetate in paste.

P3 : Polyvinyl alcohol in paste.

F1 : Finished with acrylic emulsion.

Transfer printed samples on pages 119-122

(b) The data on the transfer printability of fabrics finished with polyvinyl acetate and printed with three different pastes each containing a synthetic polymer emulsion and with a paste not containing polymer emulsion has been given in Table 5 and presented graphically in Figure 4.

FIG. 3 INFLUENCE OF FINISH (ACRYLIC) ON FABRIC AND VARYING SYNTHETIC POLYMER EMULSION IN PASTE ON TRANSFER PRINTING ABILITY OF DYE-I FOR DIFFERENT FABRICS

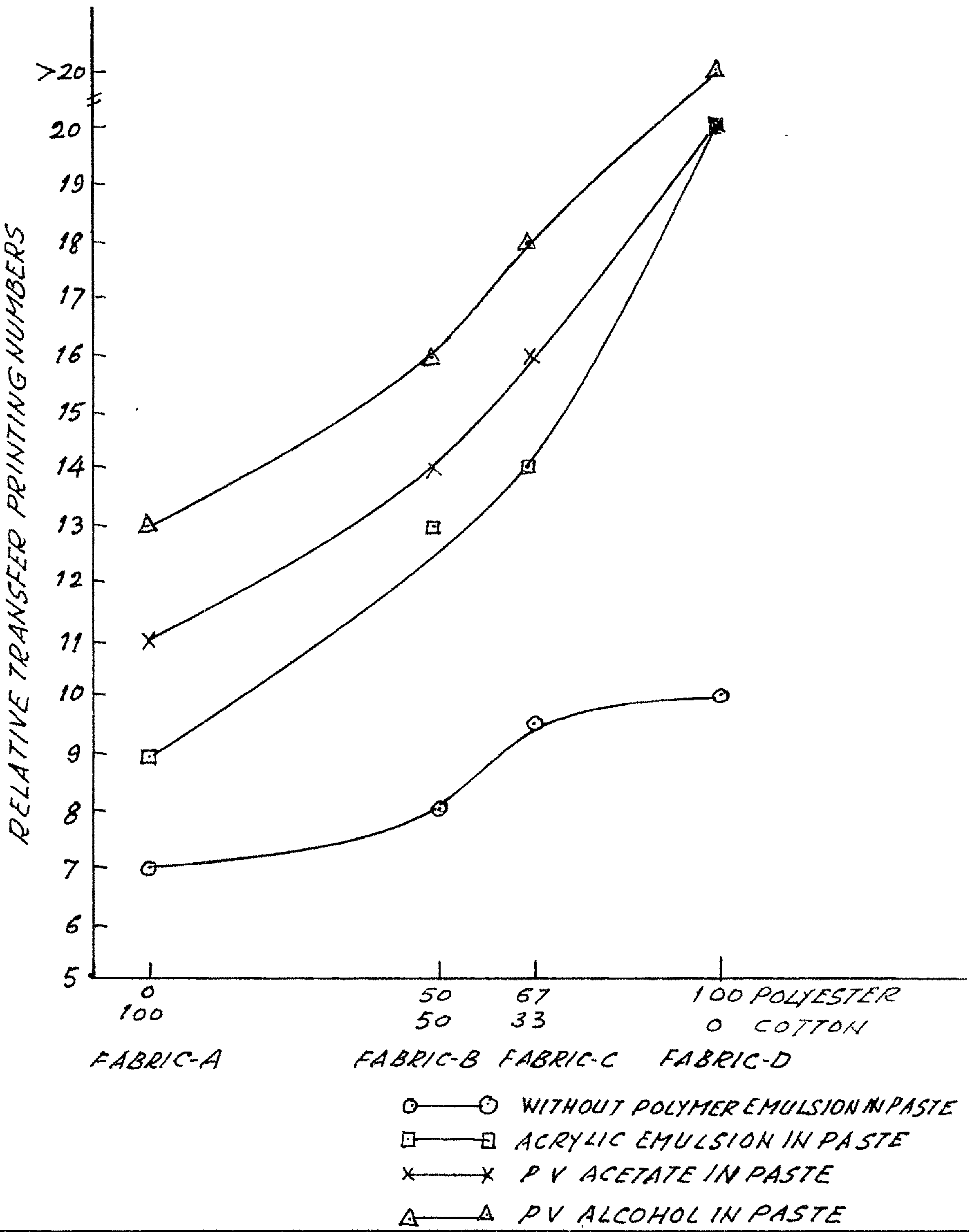


Table 5. Data on relative transfer printing number of fabrics finished by polyvinyl acetate having varying fiber content printed with varying contents in paste.

Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Po/F2	P1/F2	P2/F2	P3/F2
A	-	100	9	9.5	9.5	12.5
B	50	50	9.5	12.5	13	16
C	67	33	10	13	15	18
D	100	--	10	20	20	>20

PE : Polyester

COT : Cotton

Po : Paste without synthetic polymer emulsion.

P1 : Acrylic emulsion in paste.

P2 : Polyvinyl acetate in paste.

P3 : Polyvinyl alcohol in paste.

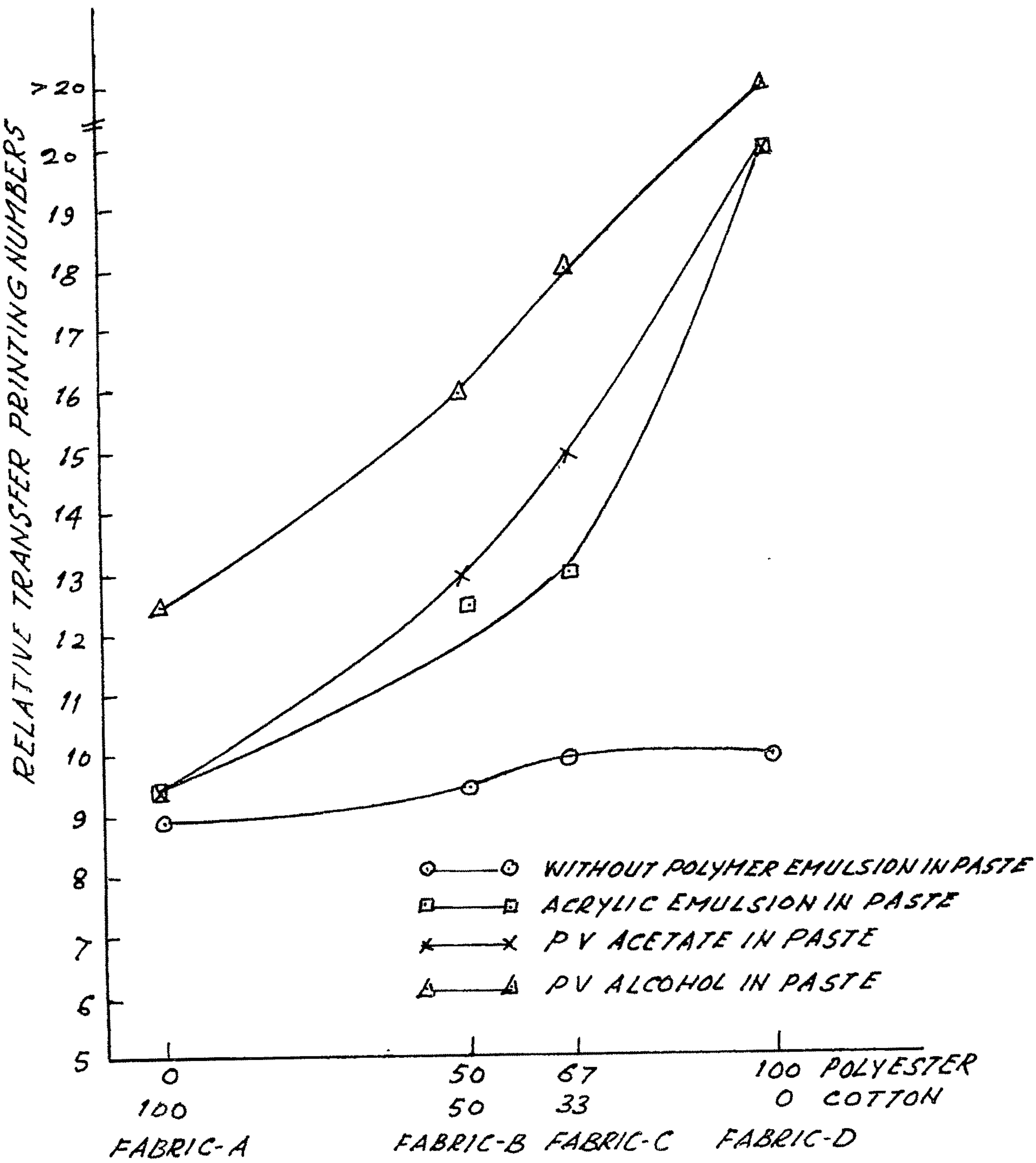
F2 : Finished with polyvinyl acetate.

Transfer printed samples on pages 128-131

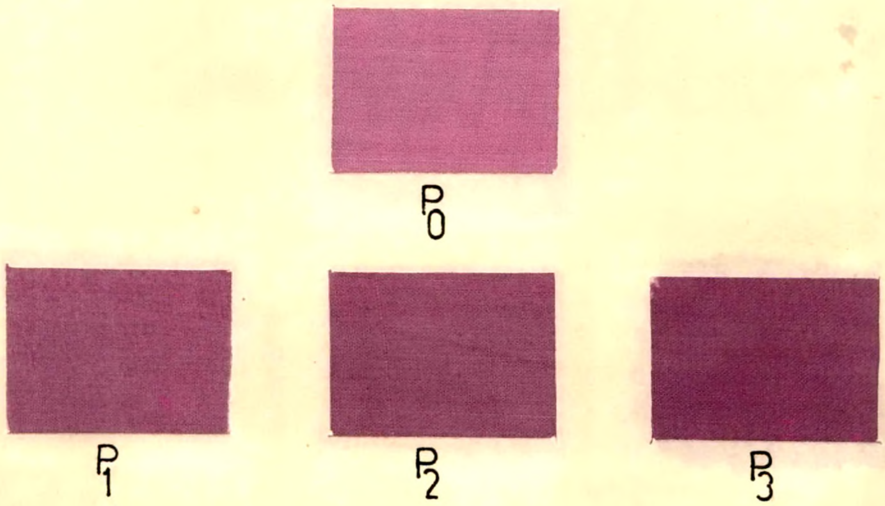
The results showed a similar trend to that of the fabrics finished with acrylic emulsion. 100 percent cotton fabric (finished) showed more transfer printability when printed with paste containing polyvinyl alcohol than 100 percent polyester fabric printed with paste not containing polymer emulsion.

(c) The data presented in Table 6 and Figure 5 showed the transfer printing ability of fabrics finished with polyvinyl

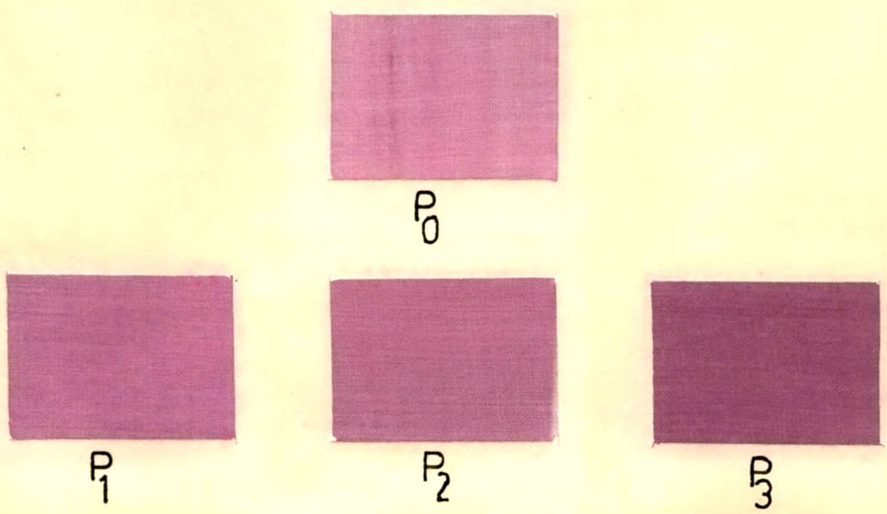
FIG. 4 INFLUENCE OF FINISH (P V ACETATE) ON FABRIC AND VARYING SYNTHETIC POLYMER EMULSION IN PASTE ON TRANSFER PRINTING ABILITY OF DYE-I FOR DIFFERENT FABRICS



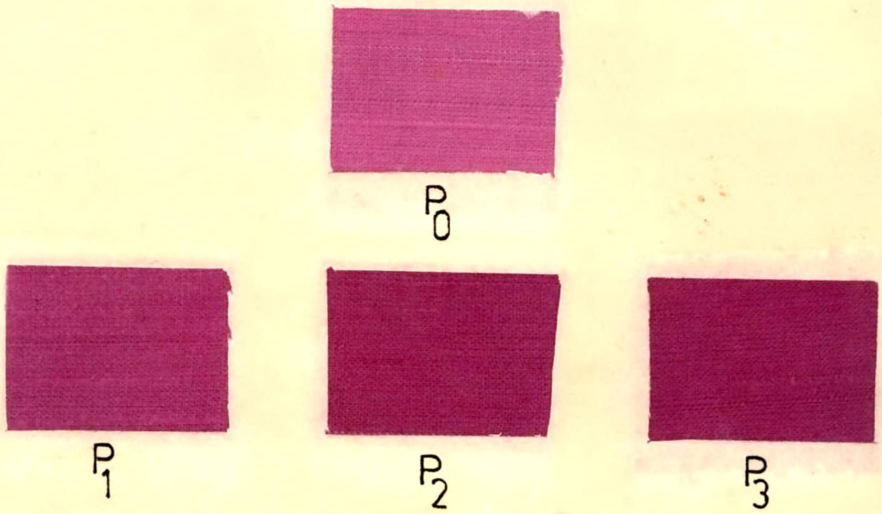
TRANSFER PRINTED SAMPLES
OF COTTON FABRICS FINISHED WITH
PV ACETATE (F2) - DYE I



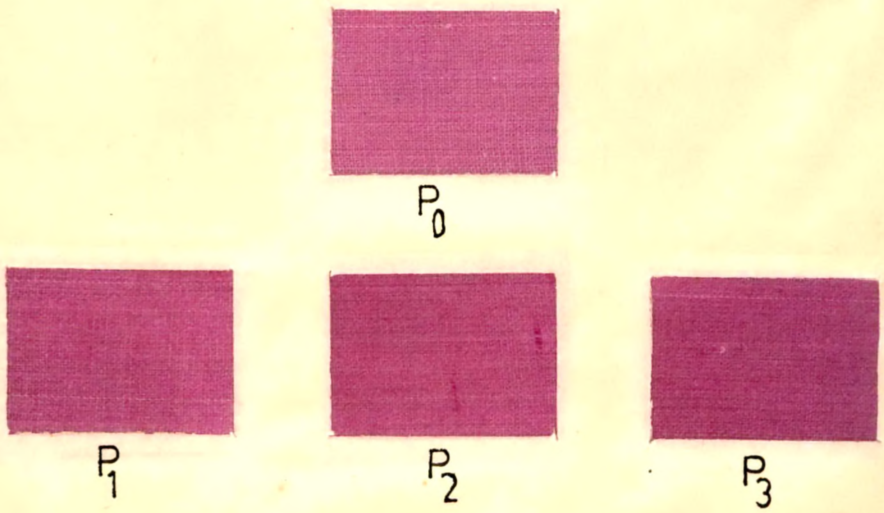
TRANSFER PRINTED SAMPLES
OF COTTON FABRICS FINISHED WITH
PV ALCOHOL (F3) - DYE I



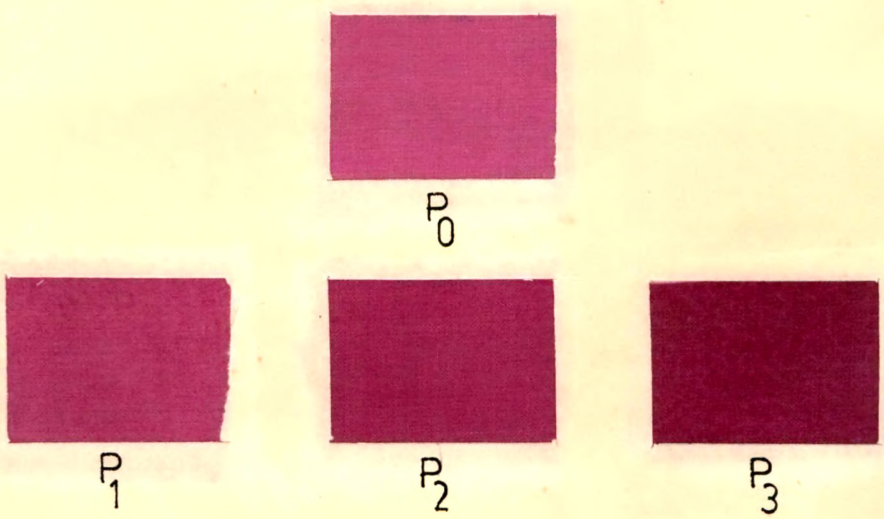
TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS FINISHED
WITH PV ACETATE (F2) - DYE I



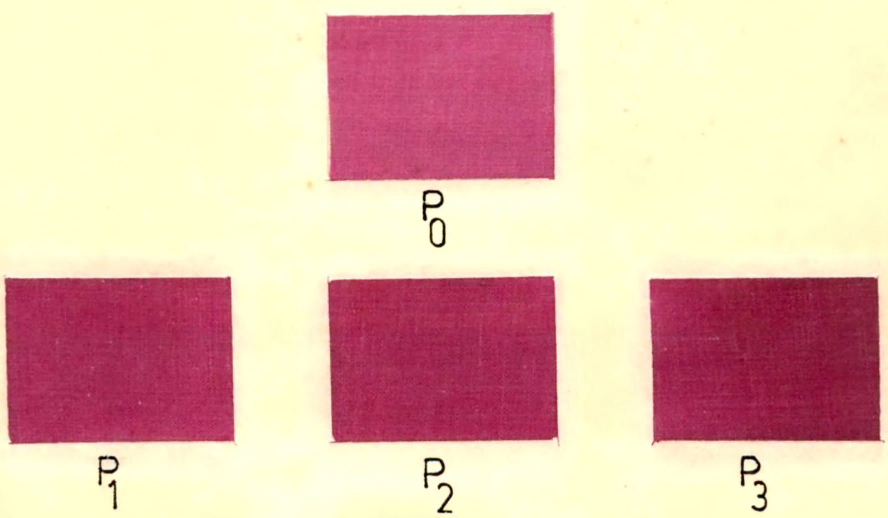
TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS FINISHED
WITH PV ALCOHOL (F3) - DYE I



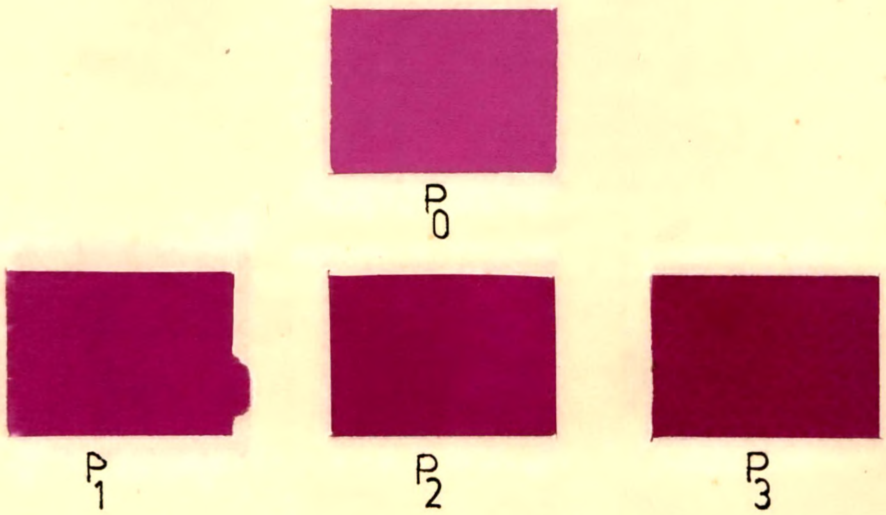
TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS FINISHED
WITH PV ACETATE (F2) - DYE I



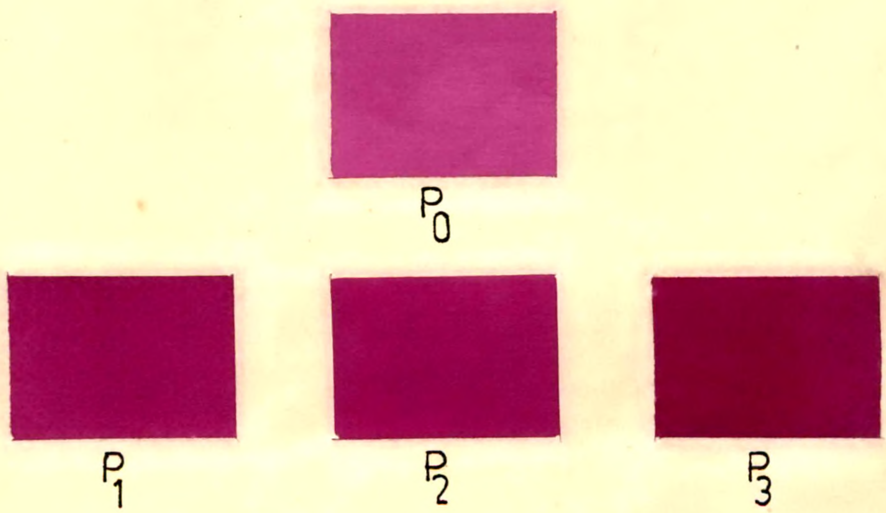
TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS FINISHED
WITH PV ALCOHOL (F3) - DYE I



TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS FINISHED WITH
PV ACETATE (F2) - DYE I



TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS FINISHED WITH
PV ALCOHOL (F3) - DYE I



alcohol and printed with three different pastes each containing a synthetic polymer emulsion.

Table 6. Data on the relative transfer printing number of fabrics finished by polyvinyl alcohol having varying fiber content printed with varying content of the paste.

Fabric code	% Fiber content		Relative transfer printing numbers			
	PE	COT	Po/F3	P1/F3	P2/F3	P3/F3
A	-	100	3	5	5	8
B	50	50	8	9	9.5	10
C	67	33	9	12	14	16
D	100	-	10	20	20	>20

PE : Polyester

COT : Cotton

Po : Paste without synthetic polymer emulsion.

P1 : Acrylic emulsion in paste.

P2 : Polyvinyl acetate in paste.

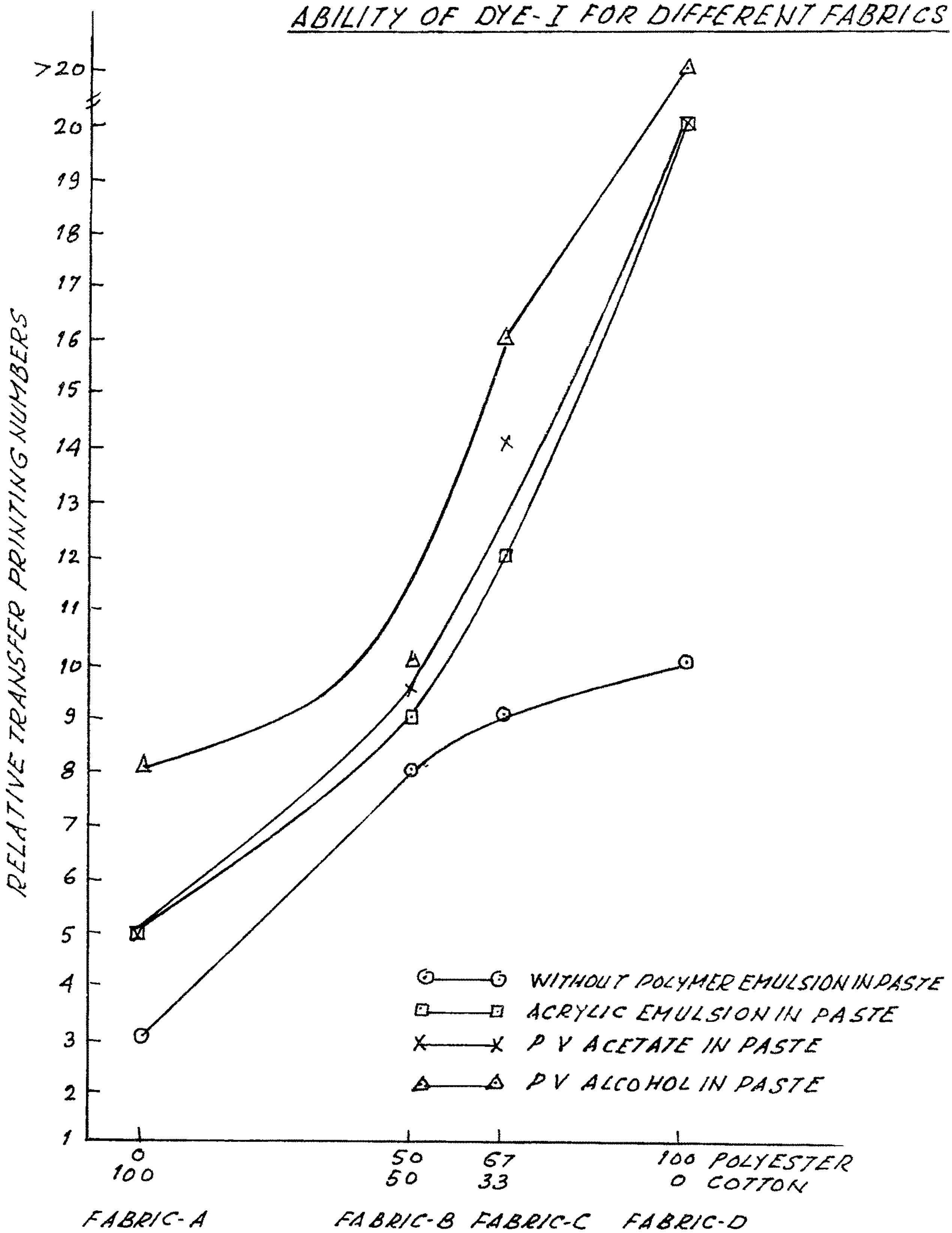
P3 : Polyvinyl alcohol in paste.

F3 : Finished with polyvinyl alcohol

Transfer printed samples on pages 128-131.

The results showed that all the fabrics had increased transfer printability when printed with paste containing polymer emulsion. The finished 100 percent cotton fabric however did not reach the transfer printability equivalent to that of 100 percent polyester even when printed with paste containing

FIG.5: INFLUENCE OF FINISH (P V ALCOHOL) ON FABRIC AND VARYING SYNTHETIC POLYMER EMULSION IN PASTE ON TRANSFER PRINTING ABILITY OF DYE-I FOR DIFFERENT FABRICS



a synthetic polymer emulsion. This was due to the film forming nature of the finish used which prevented the vapours of the dye to diffuse into the fibers.

The results of Figures 3, 4 and 5 when compared it was observed that all the three synthetic polymer emulsions had helped to increased the transfer printing ability either when applied as a finish or when added to the normal printing paste. All the combinations did not give equivalent result but the results obtained by combinations were better than the results obtained by the seperate use of polymer emulsion either as a finish or in the paste specially for 100 percent cotton fabrics and polyester cotton blends.

The finish/paste combination which gave the optimum increased transfer printability was acrylic emulsion/polyvinyl acetate as finish on fabric and polyvinyl alcohol in the paste. The finish/paste combination which gave the optimum results was checked for its fastness to washing as good washing fastness is essential if such a transfer printing has to be used for garments or household linen.

Durability of the Prints to Mild Soap Washing for Dye I.

In order to know whether the disperse dye is appropriately held by the fiber/fiber blends, it was necessary to see its washing fastness. This information namely whether the colour is superficially held or has penetrated into the fibers would also help the utility of the process studied. For this purpose, samples were washed in mild soap and dye retention after washing was assessed with standards and compared with those values before washing. These are given in Table 7 and Figure 6.

Table 7. Durability of the transfer printed samples to mild soap washing for dye I.

Finish / Fabric	Fo Before Washing	Fo After Washing	F1 Before Washing	F1 After Washing
A	6	0.5	13	8
B	10	16	16	9
C	16	14	18	15
D	> 20	>20	>20	>20

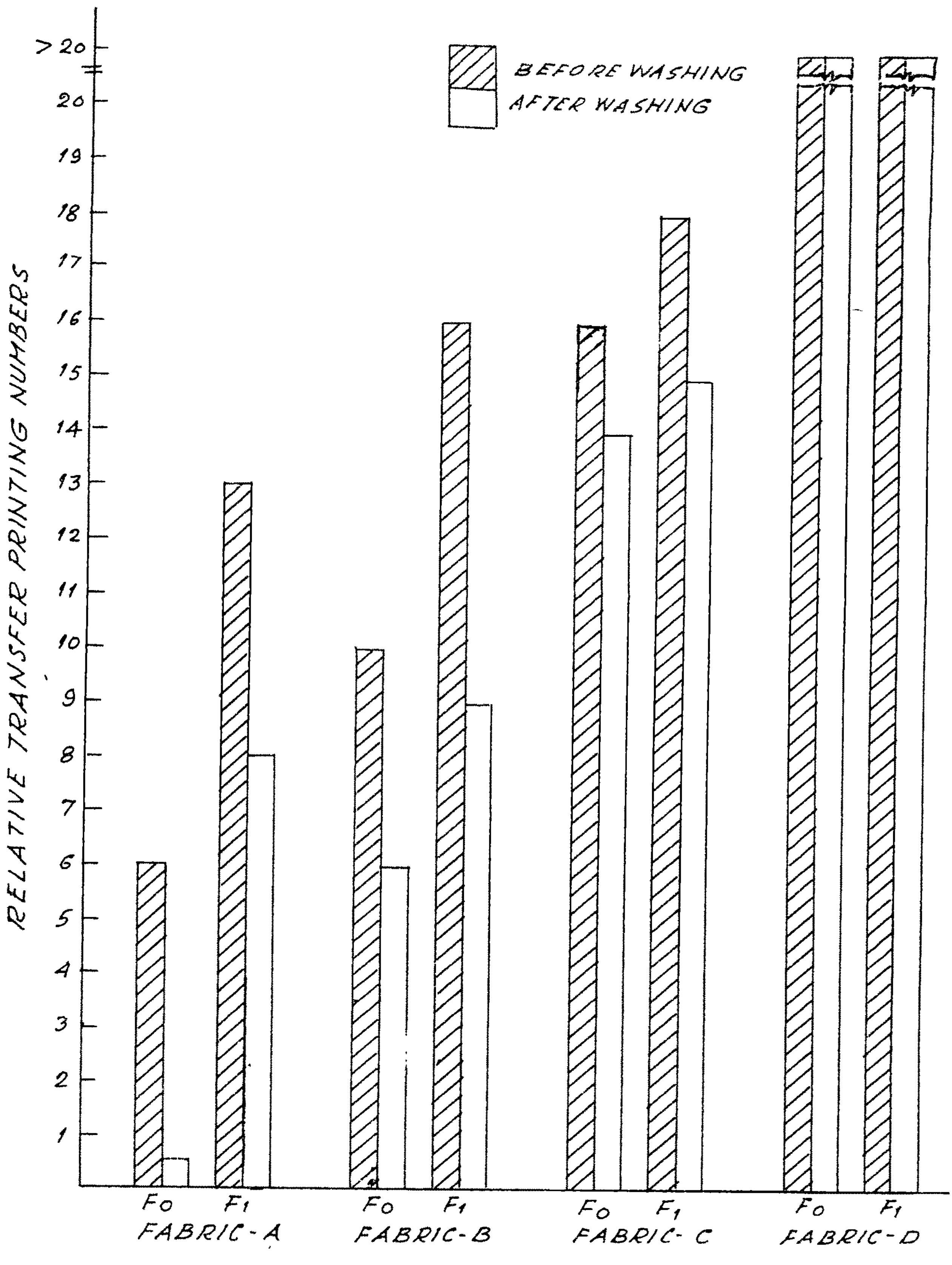
Fo : Unfinished

F1 : Finished with acrylic emulsion.

The graphical representation of values in Table 7 and Figure 6 showed that untreated 100 percent cotton and its blends with polyester showed loss of colour after washing, where as 100 percent polyester showed no loss of colour. Colour retention after washing for unfinished 100 percent cotton was almost nil. The colour retention after washing increased with the increase in the polyester content of the blend.

For finished fabrics there was an improvement in the colour retention and this was more so with 100 percent

FIG. 6 DURABILITY OF THE TRANSFER PRINTED SAMPLES TO MILD SOAP WASHING - DYE- I



cotton fabric. It showed good colour retention after washing when finished. Finished 50:50 P:C and 67:33 P:C also showed better colour retention on washing.

Unfinished 100 percent cotton fabric showed no colour retention on washing as cotton is not receptive to disperse dye. So if at all any dye was transferred on to the fabric it must have been superficially deposited and so was washed out when treated with mild soap washing. The application of finish not only made the cotton fabric receptive to the dye but it also helped the dye to penetrate into the fiber and so the dye on the finished fabric was retained even after washing.

(B) Results and Discussion for Dye II : Resolin Blue I-FBL

The results of dye I showed an improvement in the transfer print ability of fabrics by the use of synthetic polymer emulsions. To varify the effect of synthetic polymer emulsions dye II having a higher sublimation fastness than dye I was used.

In this section results on dye II are presented as:

i. The influence of varying finishes on the fabrics on the transfer printing ability.

ii. The influence of varying synthetic polymer emulsions in paste on the transfer printing ability for different fabrics.

iii. The influence of using synthetic polymer emulsion as a finish and as a component in the paste on the transfer printing ability for different fabrics.

i. The influence of varying finishes on the fabrics on the transfer printing ability:

The fabrics used were finished with all the three synthetic polymer emulsions and were studied along with the unfinished fabrics for their relative transfer printing ability. The data regarding these have been given in Table 8 and presented graphically in Figure 7.

It was expected to get a similar effect on the transfer printing ability as in case of dye I.

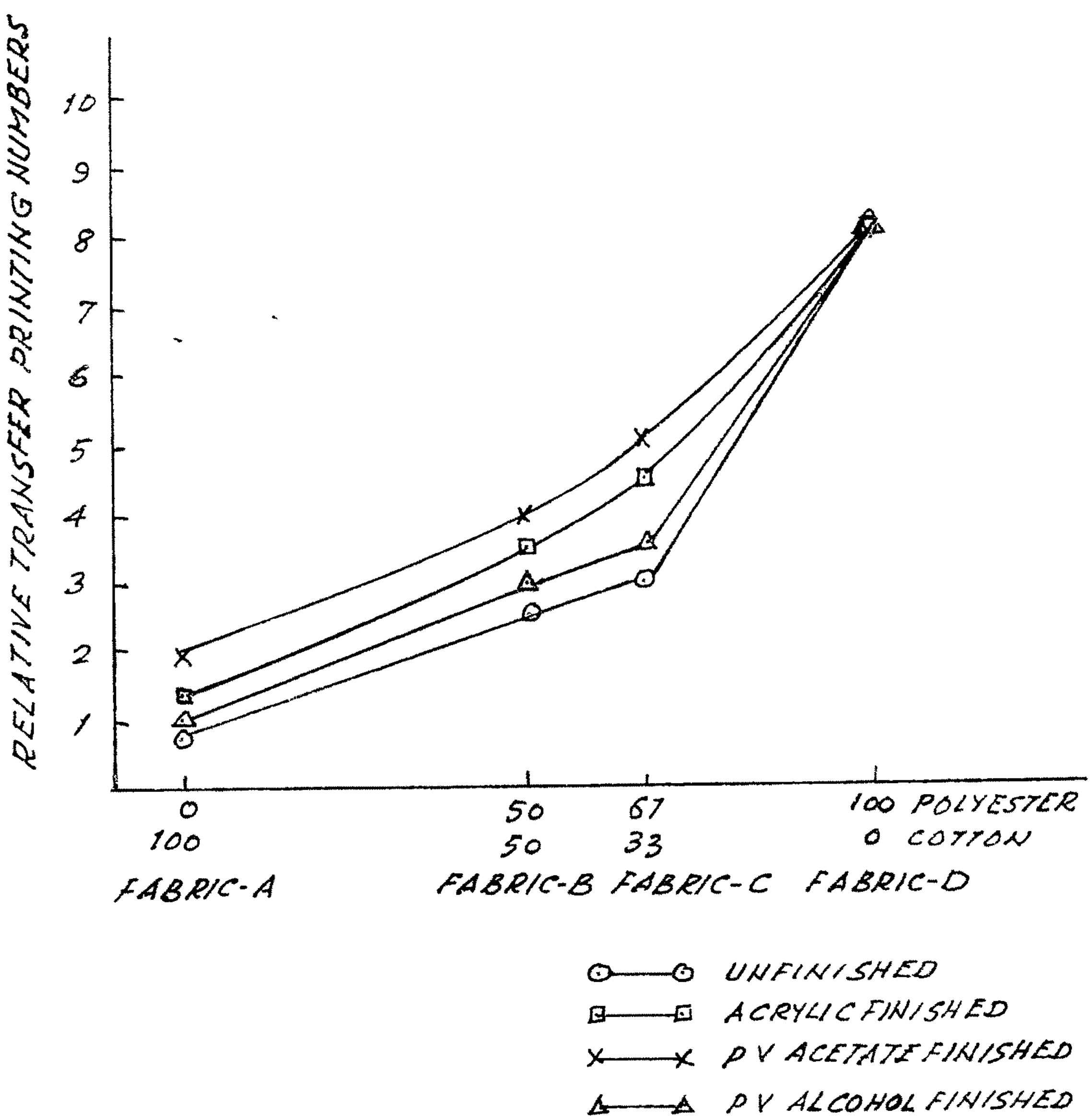
Table 8. Data on relative transfer printing number (for dye II) of different fabrics at varying finish treatments.

Fabric code	% Fiber content		Relative transfer printing numbers			
	PE	COT	Fo/Po	F1/Po	F2/Po	F3/Po
A	-	100	0.75	1.4	2	1
B	50	50	2.5	3.5	4	3
C	67	33	3	4.5	5	3.5
D	100	-	8	8	8	8

COT : Cotton
PE : Polyester
Fo : Unfinished.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without polymer emulsion.
Transfer printed samples on pages 144-147, 154-157

As seen from these values, cotton and its blends with polyester when finished showed an increase, though not marked, as observed in dye I, in the transfer printing ability than the corresponding unfinished fabrics. 100 percent polyester fabric showed no change in the transfer printing ability after finishing. The synthetic polymer emulsion as finish did not have any influence to improve the transfer printing ability of polyester. Finished polyester:cotton (67:33) blend had an improved transfer printing ability but not comparable to 100 percent polyester. Finish polyvinyl acetate and acrylic emulsion showed some (though small) influence for improving

FIG. 7 INFLUENCE OF VARYING FINISHES IN FABRICS ON TRANSFER PRINTING ABILITY OF DYE-II FOR DIFFERENT FABRICS



the transfer printing ability. Polyvinyl alcohol did not show much influence for improving the transfer printing ability.

These results thus had a similar trend as that of dye I. To increase the transfer print ability on 100 percent polyester and to improve the transfer print ability of 100 percent cotton and its blends with polyester, the polymer emulsion was then incorporated in the printing paste, the results of which are discussed in the next section (ii).

ii. The influence of varying synthetic polymer emulsion in paste on the transfer printing ability for different fabrics.

Since there was very little influence of the synthetic polymer emulsion as finish on the transfer printing of dye II, it was thought to varify the influence of synthetic polymer emulsion when used in the paste. The fabrics used for transfer printing were thus unfinished while the three synthetic polymer emulsions were incorporated in the printing paste separately. These were studied and their relative transfer printing abilities were compared with those of paste without any synthetic polymer emulsion. The data is presented in Table 9 and shown graphically in Figure 8.

All the fabrics showed higher transfer printing ability when printed with paste containing synthetic polymer emulsion than when printed with paste not containing synthetic polymer emulsion.

Table 9. Data on relative transfer printing number (for dye II) of different fabrics printed with varying content of the paste.

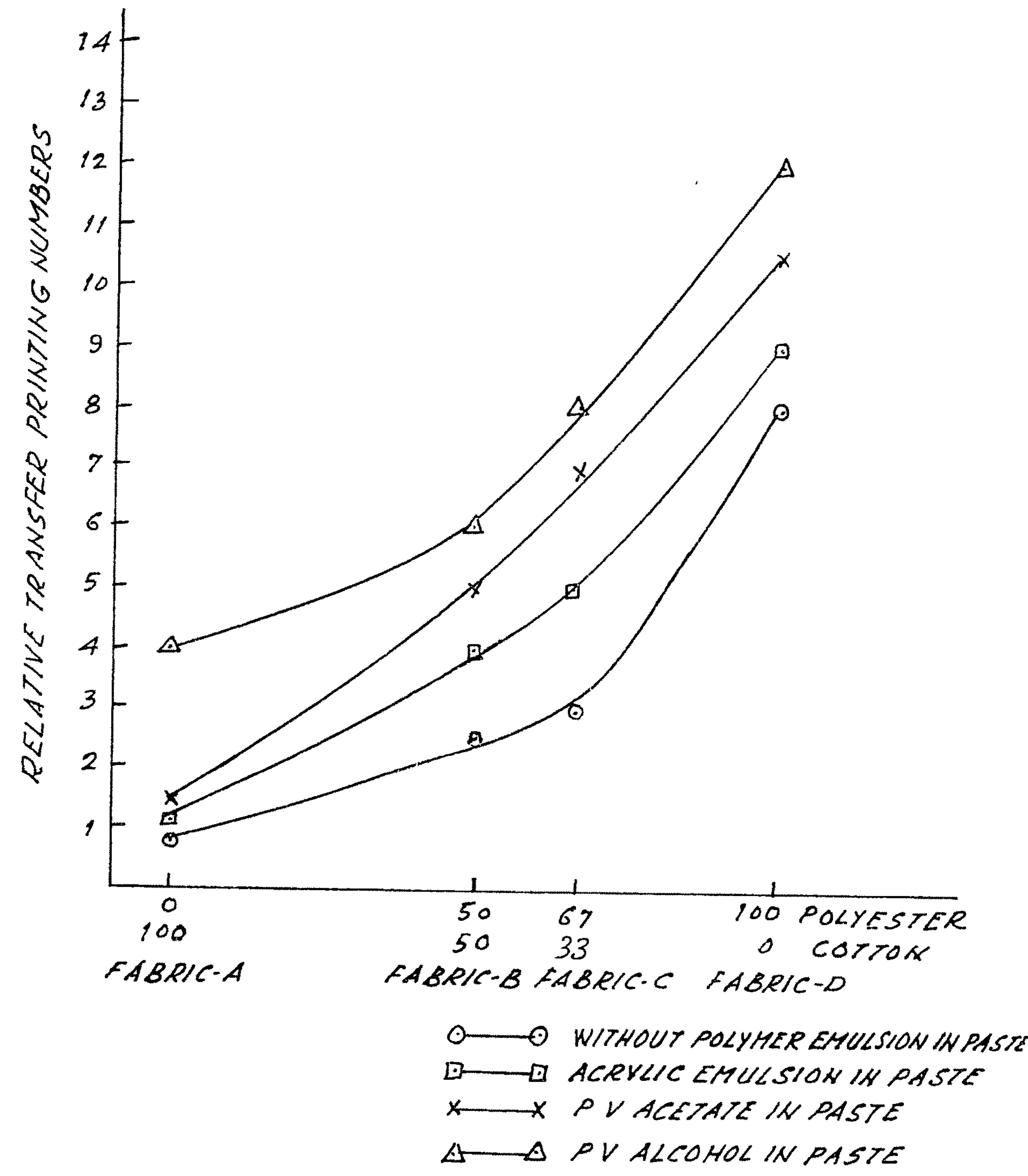
Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Po/Fo	P1/Fo	P2/Fo	P3/Fo
A	-	100	0.75	1.1	1.4	4
B	50	50	2.5	4	5	6
C	67	33	3	5	7	8
D	100	-	8	9	10.5	12

COT : Cotton
PE : Polyester
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.
Fo : Unfinished fabric.

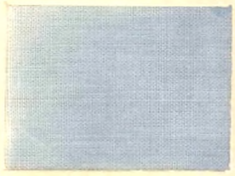
Transfer printed samples on pages 144-147

100 percent cotton printed with paste containing polyvinyl alcohol and 50:50 polyester:cotton printed with paste containing acrylic emulsion had the same relative transfer number 4. Cotton fabrics printed with paste containing polyvinyl alcohol showed a little more transfer printing ability than 67:33 polyester:cotton printed by a paste without any synthetic polymer emulsion. 67:33 polyester:cotton printed with paste containing polyvinyl alcohol and 100 percent polyester printed by paste without any synthetic polymer emulsion showed the same relative transfer printing ability.

FIG. 8 INFLUENCE OF VARYING SYNTHETIC POLYMER EMULSIONS IN PASTE ON THE TRANSFER PRINTING ABILITY OF DYE-II FOR DIFFERENT FABRICS



TRANSFER PRINTED SAMPLES
OF COTTON FABRICS UNFINISHED (Fo) - DYE II



P_0

P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF COTTON FABRICS FINISHED WITH ACRYLIC
EMULSION (F1) - DYE II

P_0

P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS UNFINISHED
(Fo) - DYE II

P_0

P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS FINISHED
WITH ACRYLIC EMULSION (F1) - DYE II

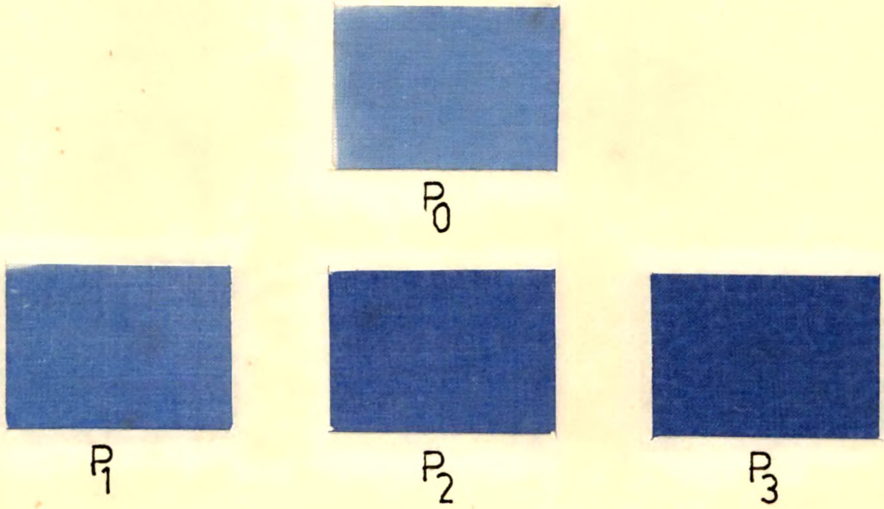
P_0

P_1

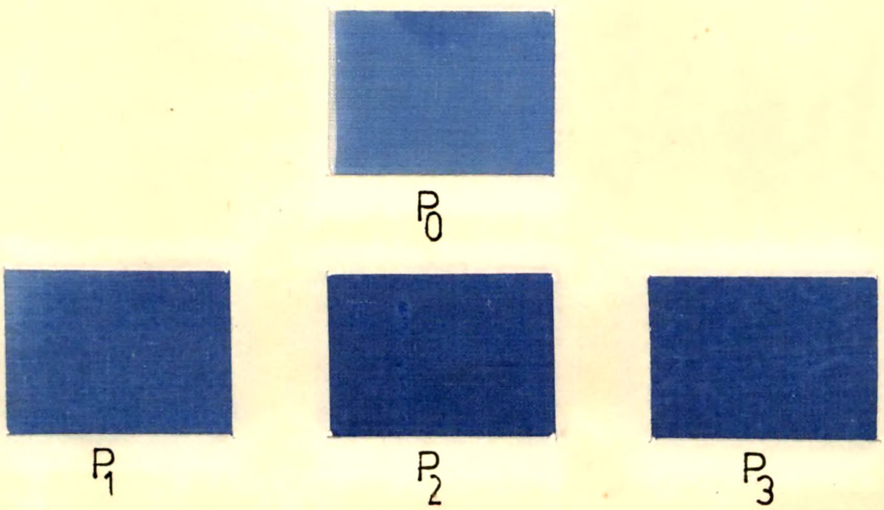
P_2

P_3

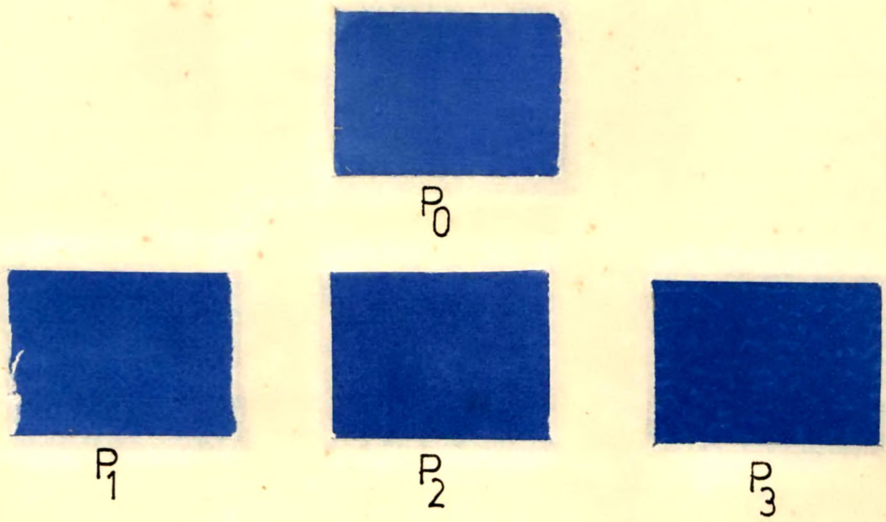
TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS UNFINISHED
(Fo) - DYE II



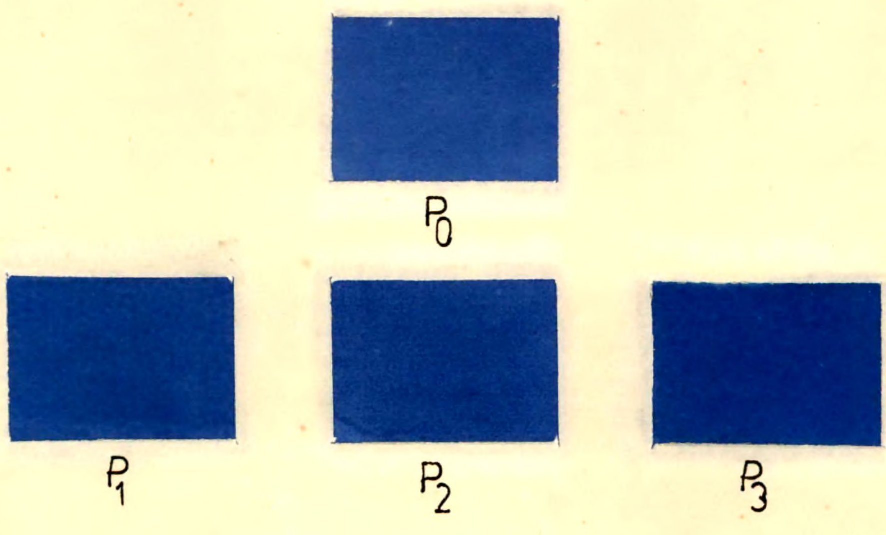
TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS FINISHED
WITH ACRYLIC EMULSION (F1) - DYE II



TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS UNFINISHED (Fo) - DYE II



TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS FINISHED WITH
ACRYLIC EMULSION (F1) - DYE II



The influence of the synthetic polymer emulsion to improve the transfer printing ability by incorporating them in the printing paste was similar in trend for all the fabrics but it varied in its degree of improvement. Polyvinyl alcohol showed a marked influence for improving the transfer printing ability. Polyvinyl acetate showed intermediate and acrylic emulsion showed less influence. When these synthetic polymer emulsions were used as a finish they did not show much influence to increase the transfer printing ability.

The results of dye II showed that the synthetic polymer emulsions when used either as a finish in the paste did not improve as much transfer print ability of fabric as they did for dye I. Thus a combined use of the synthetic polymer emulsion as a finish and in the paste was tried to get improved transfer print ability, as explained below (iii).

iii. The influence of using synthetic polymer emulsion as a finish and as a component in the paste on the transfer printing ability for different fabrics.

In this part of work, different finish/paste combinations were used. The fabrics were finished with one synthetic polymer emulsion and printed by the three pastes containing different polymer emulsions while one paste was without a polymer emulsion.

The data has been given in Tables 10 to 12 and presented graphically in Figures 9 to 11.

(a) The data for the fabrics finished with acrylic emulsion and printed with three different pastes each containing one polymer emulsion and a paste without a synthetic polymer emulsion have been given in Table 10 and Figure 9.

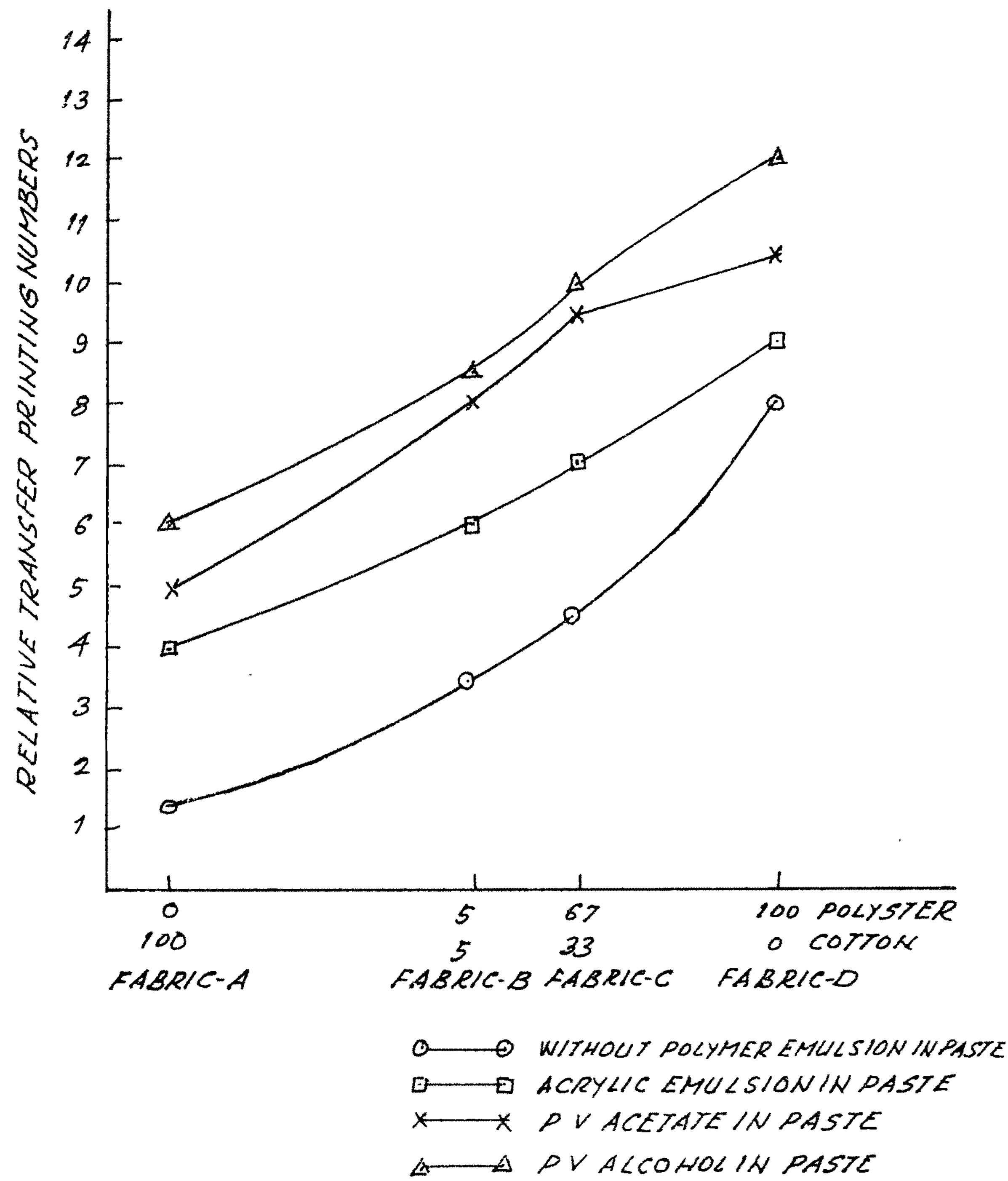
The data on the transfer print ability of all the finished fabrics printed with pastes containing a synthetic polymer emulsion when compared with the data of the finished fabrics printed with paste not containing a synthetic polymer emulsion showed increased transfer printability for all the fabrics.

Table 10. Data on relative transfer printing number of fabrics finished by acrylic emulsion (F1) having varying fiber content, printed with varying contents in paste.

Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Po/F1	P1/F1	P2/F1	P3/F1
A	-	100	1.4	4	5	6
B	50	50	3.5	6	8	8.5
C	67	33	4.5	7	9.5	10
D	100	-	8	9	10.5	12

COT : Cotton.
PE : Polyester.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.
F1 : Finished with acrylic emulsion.
Transfer printed samples on pages 144-147

FIG. 9 INFLUENCE OF FINISH (ACRYLIC) ON FABRIC AND VARYING SYNTHETIC POLYMER EMULSION IN PASTE ON TRANSFER PRINTING ABILITY OF DYE-II FOR DIFFERENT FABRICS



100 percent cotton fabric printed with paste containing polyvinyl alcohol and 50:50 polyester:cotton printed with paste containing acrylic emulsion showed the same transfer printability.

100 percent cotton finished with acrylic emulsion and printed with paste containing polyvinyl alcohol showed more transfer printability than 67:33 polyester:cotton finished with acrylic emulsion and printed with paste not containing a synthetic emulsion.

50:50 polyester:cotton printed with paste containing polyvinyl acetate and 100 percent polyester printed by paste without any synthetic polymer emulsion showed the same relative transfer print ability. Such a result was due to the fabric being have made first receptive to the disperse dye and then it was transfer printed with a paste containing a synthetic polymer emulsion.

(b) The data on the transfer print ability of fabrics finished with polyvinyl acetate and printed with three different pastes each containing a synthetic polymer emulsion and with a paste not containing polymer emulsion has been given in Table 11 and Figure 10.

The transfer print ability of all the polyvinyl acetate finished fabrics was more when printed with paste containing synthetic polymer emulsion than when printed with paste not containing synthetic polymer emulsion which showed a similar trend as the fabrics finished with acrylic emulsion.

Table 11. Data on relative transfer printing number of fabrics finished by polyvinyl acetate (F2) having varying fiber content printed with varying content in paste.

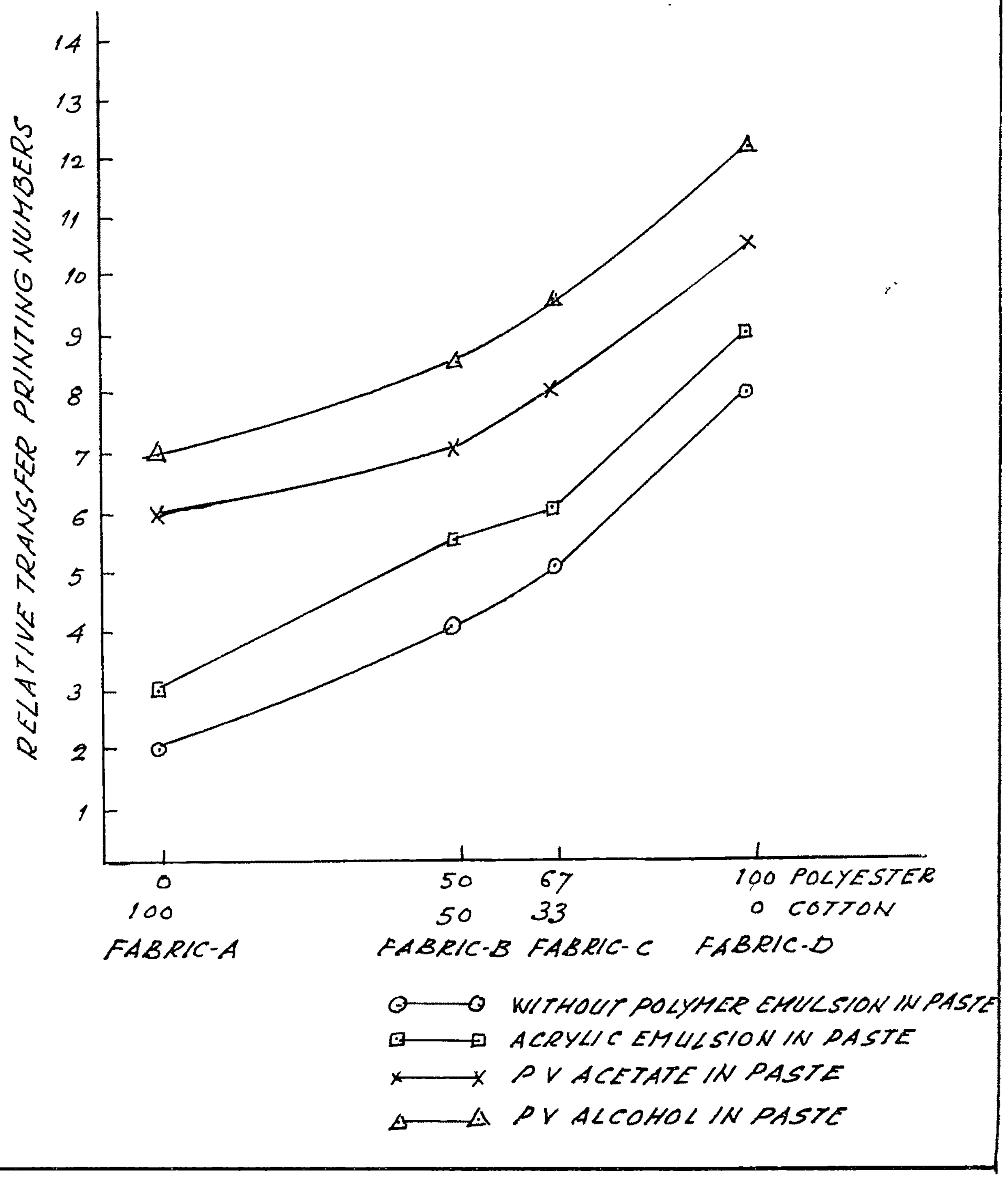
Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Po/F2	P1/F2	P2/F2	P3/F2
A	-	100	2	3	6	7
B	50	50	4	5.5	7	8.5
C	67	33	5	6	8	9.5
D	100	-	8	9	10.5	12

COT : Cotton.
PE : Polyester.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.
F2 : Finished with polyvinyl acetate.
Transfer printed samples on pages 154-157

50:50 polyester:cotton printed with paste containing polyvinyl alcohol showed the same transfer print ability as 100 percent polyester printed with paste not containing synthetic polymer emulsion.

(c) The data presented in Table 12 and Figure 11 shows the transfer printing ability of fabrics finished with polyvinyl alcohol and printed with three different paste each

FIG. 10 INFLUENCE OF FINISH (P V ACETATE) ON FABRIC AND VARYING SYNTHETIC POLYMER EMULSION IN PASTE ON TRANSFER PRINTING ABILITY OF DYE-II FOR DIFFERENT FABRICS



TRANSFER PRINTED SAMPLES
OF COTTON FABRICS FINISHED WITH
PV ACETATE (F2) - DYE II

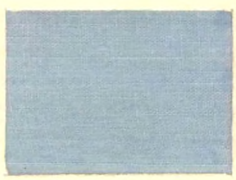
P_0

P_1

P_2

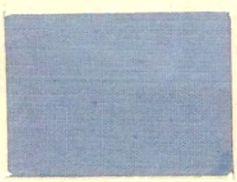
P_3

TRANSFER PRINTED SAMPLES
OF COTTON FABRICS FINISHED WITH
PV ALCOHOL (F3) - DYE II

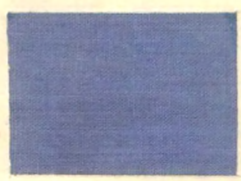


P_0

P_1

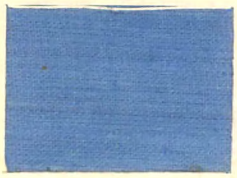


P_2



P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS FINISHED
WITH PV ACETATE (F2) - DYE II



P_0

P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS FINISHED
WITH PV ALCOHOL (F3) - DYE II

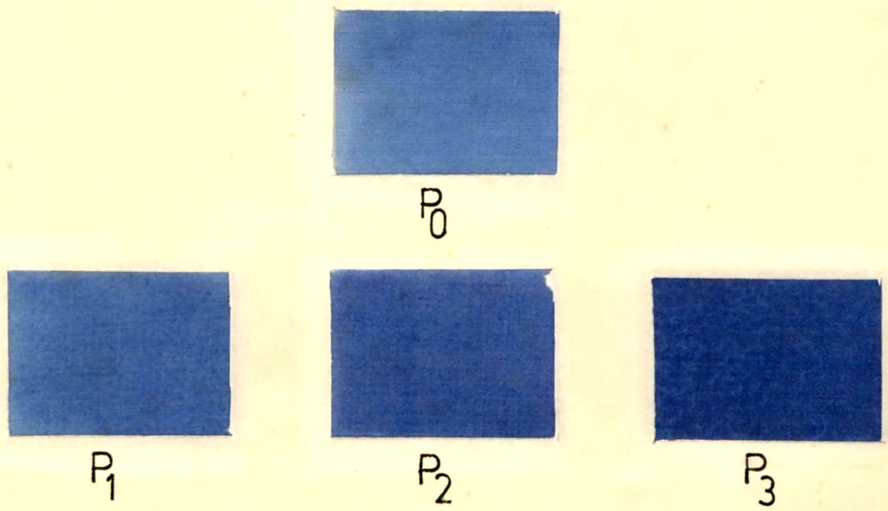
P_0

P_1

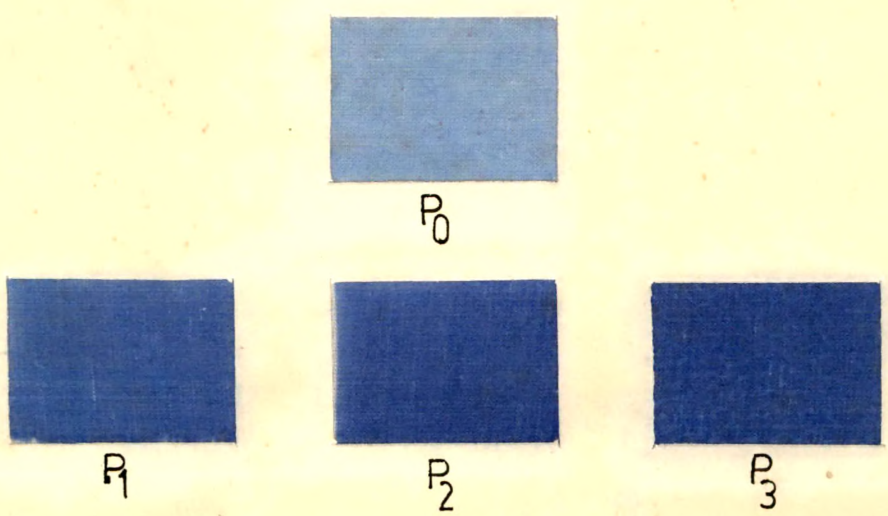
P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS FINISHED
WITH PV ACETATE (F2) - DYE II



TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS FINISHED
WITH PV ALCOHOL (F3) - DYE II



TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS FINISHED WITH
PV ACETATE (F2) - DYE II

P_0

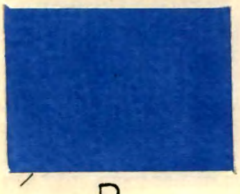
P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS FINISHED WITH
PV ALCOHOL (F3) - DYE III

P_0



P_1

P_2

P_3

containing one polymer emulsion and a paste without any synthetic polymer emulsion.

The results showed that all the polyvinyl alcohol finished fabrics had increased transfer print ability when printed with paste containing synthetic polymer emulsion.

Table 12. Data on relative transfer printing number of fabrics finished by polyvinyl alcohol (F3) having varying fiber content printed with varying contents of the paste.

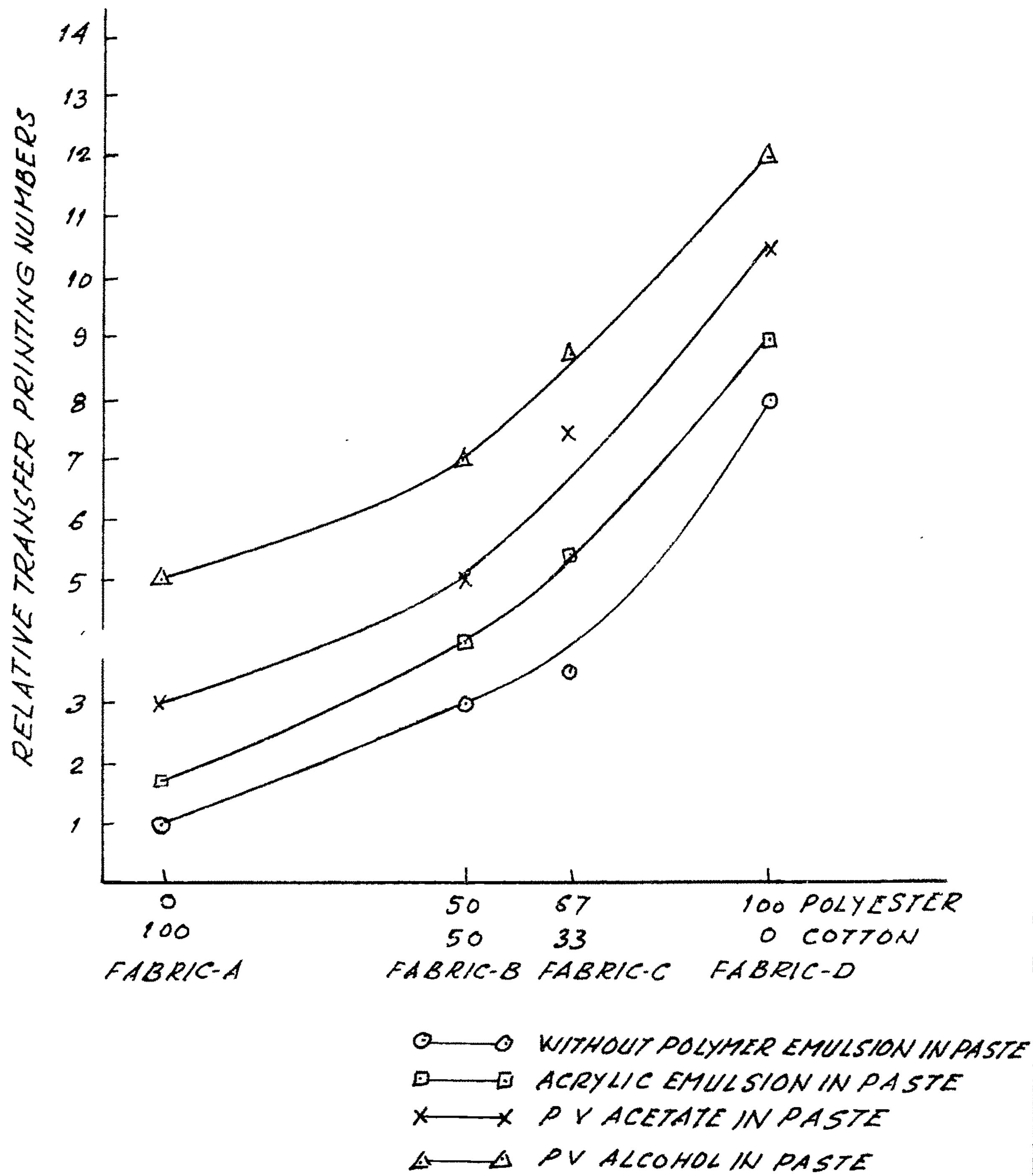
Fabric code	% Fabric Content		Relative transfer printing numbers			
	PE	COT	Po/F3	P1/F3	P2/F3	P3/F3
A	-	100	1	1.7	3	5
B	50	50	3	4	5	7
C	67	33	3.5	5.5	7.5	8.75
D	100	-	8	9	10.5	12

COT : Cotton.
PE : Polyester.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.
F3 : Fabrics finished with polyvinyl alcohol.

Transfer printed samples on pages 154-157

50:50 polyester:cotton finished with polyvinyl alcohol and printed with paste containing polyvinyl alcohol did not show transfer printability equal to that of 100 percent polyester finished with polyvinyl alcohol and printed with

FIG. 11 INFLUENCE OF FINISH (P V ALCOHOL) ON FABRIC AND VARYING SYNTHETIC POLYMER EMULSION IN PASTE ON TRANSFER PRINTING ABILITY OF DYE-II FOR DIFFERENT FABRICS



paste not containing synthetic polymer emulsion as shown by 50:50 polyester:cotton similarly printed but finished with acrylic emulsion/polyvinyl acetate. This could be due to the film forming nature of the finish used.

The results of using synthetic polymer emulsions as finish/paste combinations of dye II when compared to those of dye I showed that in dye II the 100 percent cotton fabrics could not attain transfer print ability equal to that of 100 percent polyester fabrics, however 50:50 polyester:cotton did obtain transfer print ability equal to that of 100 percent polyester fabric. This limitation could have been due to dye II having a higher sublimation fastness than dye I.

All the finish/paste combinations though did not show the same result, showed increased transfer print ability for all the fabrics as compared to when the synthetic finish polymer emulsion when used in paste separately.

The finish/paste combination which gave the optimum increased transfer print ability was acrylic emulsion/polyvinyl acetate as finish and polyvinyl alcohol in the paste.

Washing fastness of the samples finished with acrylic emulsion and printed with paste containing polyvinyl alcohol was carried out.

Durability of the prints to mild soap washing for dye II.

The washing fastness of the samples finished with acrylic emulsion and printed with paste containing polyvinyl alcohol was checked in order to know whether the disperse dye is appropriately held by the fiber/fiber blend. These results are given in Table 13 and presented graphically in Figure 12.

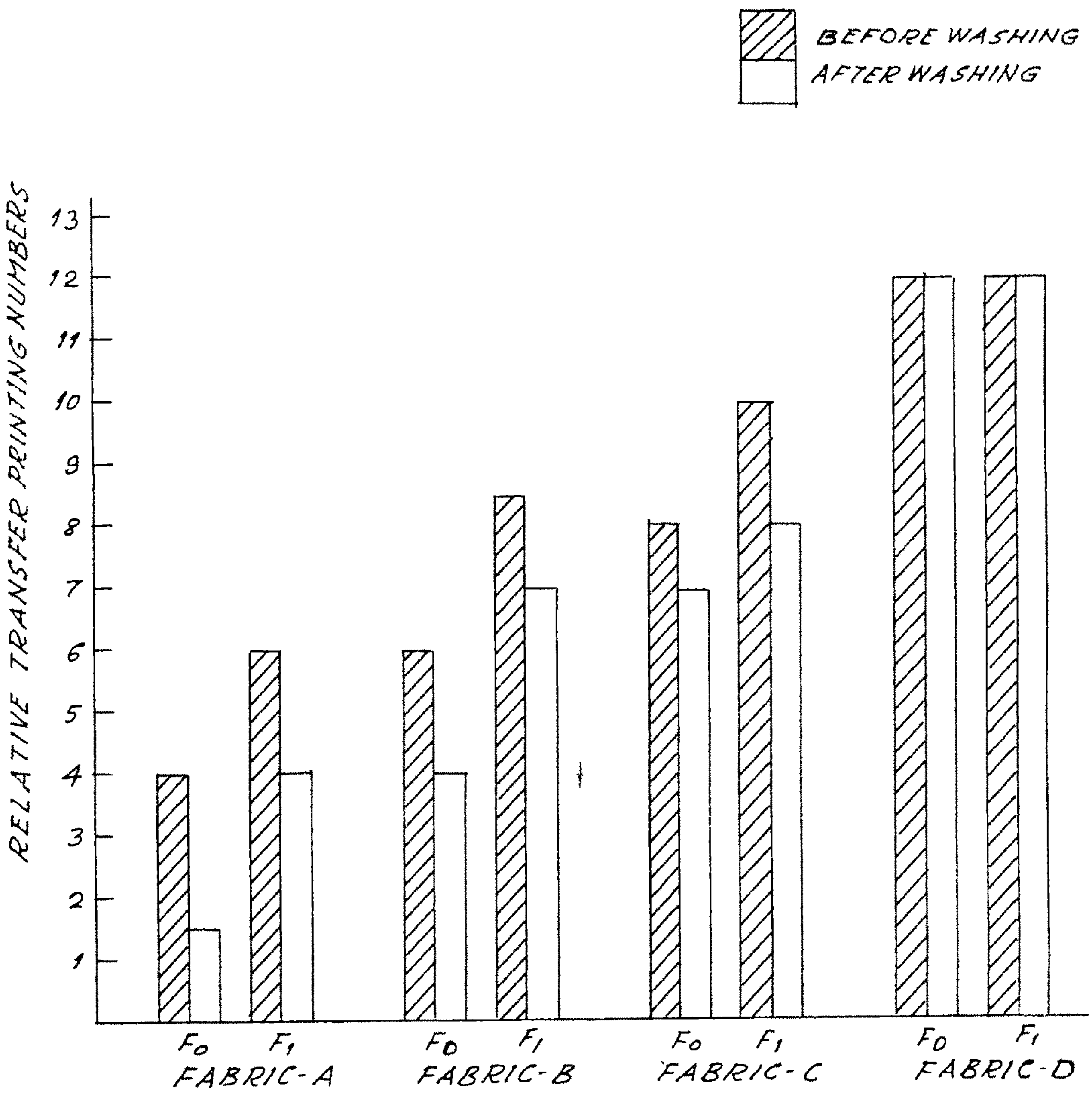
Table 13. Durability of the transfer printed samples to mild soap washing for dye II.

Finish / Fabric	Fo Before Washing	Fo After Washing	F1 Before Washing	F1 After Washing
A	4	1.5	6	4
B	6	4	8.5	7
C	8	7	10	8
D	12	12	12	12

The data showed that there was a loss of colour in unfinished 100 percent cotton and its blends with polyester on washing, while 100 percent polyester showed no colour loss. The increase in polyester content of the fabric increased the colour retention after washing. The acrylic emulsion finished fabrics showed better retention of colour on washing, and this was more so with 100 percent cotton fabric, which showed good colour retention after washing when finished.

The finished fabrics showed better colour retention after

FIG. 12 DURABILITY OF THE TRANSFER PRINTED SAMPLES TO MILD SOAP WASHING - DYE-II



washing, as the finish must have assisted the dye penetration into the fabric.

(c) <u>Results and discussion for dye III - Navilene Scarlet RR</u>.

In this section the transfer printing results of dye III are given. Dye II which had a higher sublimation fastness than dye I showed lower transfer printing ability even after using the synthetic polymer emulsion as a finish or in the paste or as finish/paste combination, so dye III with a sublimation fastness higher than dye II was used to check whether the results of dye II obtained, were due to the higher sublimation fastness of that dye or that the synthetic polymer emulsions did not have their influence for improving the transfer printing results for dye III have been given as:

i. The fnfluence of varying finishes on the fabrics on the transfer printing ability.

ii. The influence of varying synthetic polymer emulsions in paste on the transfer printing ability for different fabrics.

iii. The influence of using synthetic polymer emulsion as a finish and as a component in the paste on the transfer printing ability for different fabrics.

i. The influence of varying finishes on the fabrics on the transfer printing ability.

The fabrics used were finished with the synthetic polymer emulsions and were studied along with the unfinished fabrics for their relative transfer printing ability. The data regarding these is presented graphically in Figure 13 and given in Table 14.

The general trend of the influence to increase the transfer printing ability for all the fabrics was similar to dye I and dye II but the influence was marginal, due to the higher sublimation fastness of the dye.

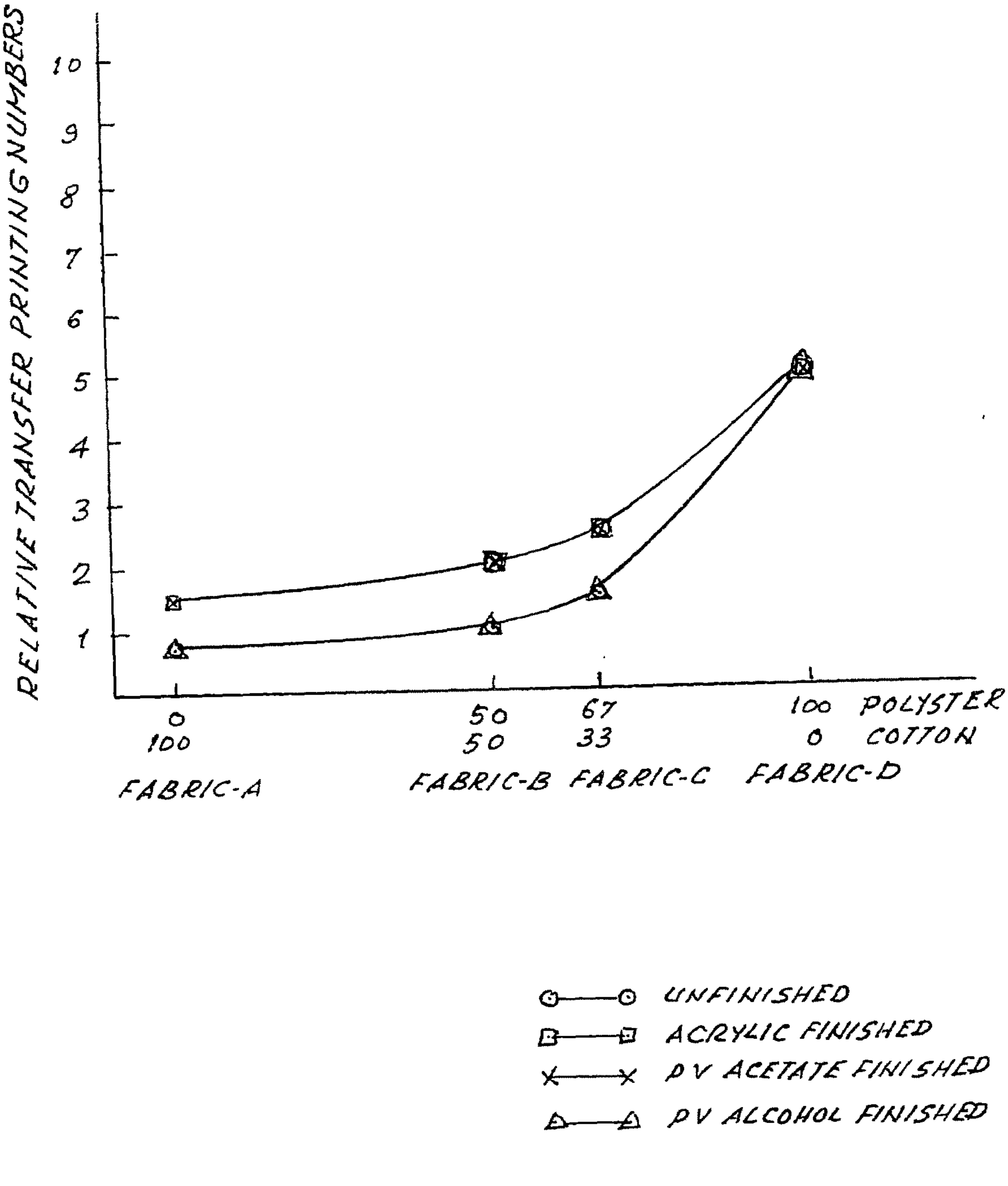
Table 14. Data on relative transfer printing number of different fabrics at varying finish treatments.

Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Fo/Po	F1/Po	F2/Po	F3/Po
A	-	100	0.95	1.5	1.5	0.75
B	50	50	1	2	2	1
C	67	33	1.5	2.5	2.5	1.5
D	100	-	5	5	5	5

COT : Cotton.
PE : Polyester.
Fo : Unfinished.
F1 : Finished with acrylic emulsion. (5%)
F2 : Finished with polyvinyl acetate (5%).
F3 : Finished with polyvinyl alcohol (5%).
Po : Paste without synthetic polymer emulsion.
Transfer printed samples on pages 169-172, 178-181

165

FIG. 13 INFLUENCE OF VARYING FINISHES IN FABRICS ON TRANSFER PRINTING ABILITY OF DYE-III FOR DIFFERENT FABRICS



Acrylic emulsion and polyvinyl acetate showed relatively more influence for improving the transfer printability than polyvinyl alcohol.

100 percent cotton finished with acrylic emulsion and polyvinyl acetate and unfinished 67:33 polyester:cotton showed the same relative transfer printing ability. The relative transfer printing ability of unfinished and finished 100 percent polyester was the same showing no influence of finish.

(c) ii. The influence of varying synthetic polymer emulsion in paste on the transfer printing ability for different fabrics.

The fabrics used were unfinished. The three synthetic polymer emulsion were incorporated in the printing paste separately and were studied for their relative transfer printing ability along with the paste without any synthetic polymer emulsion. The data is presented in Table 15 and shown graphically in Figure 14.

The general trend of the result was similar in dye I and II. The influence of the synthetic polymer emulsion on paste for increasing the transfer printing ability was specifically observed in 100 percent polyester fabrics as compared to the other fabrics.

Table 15. Data on relative transfer printing number (dye III) of different fabrics printed with varying content of the paste.

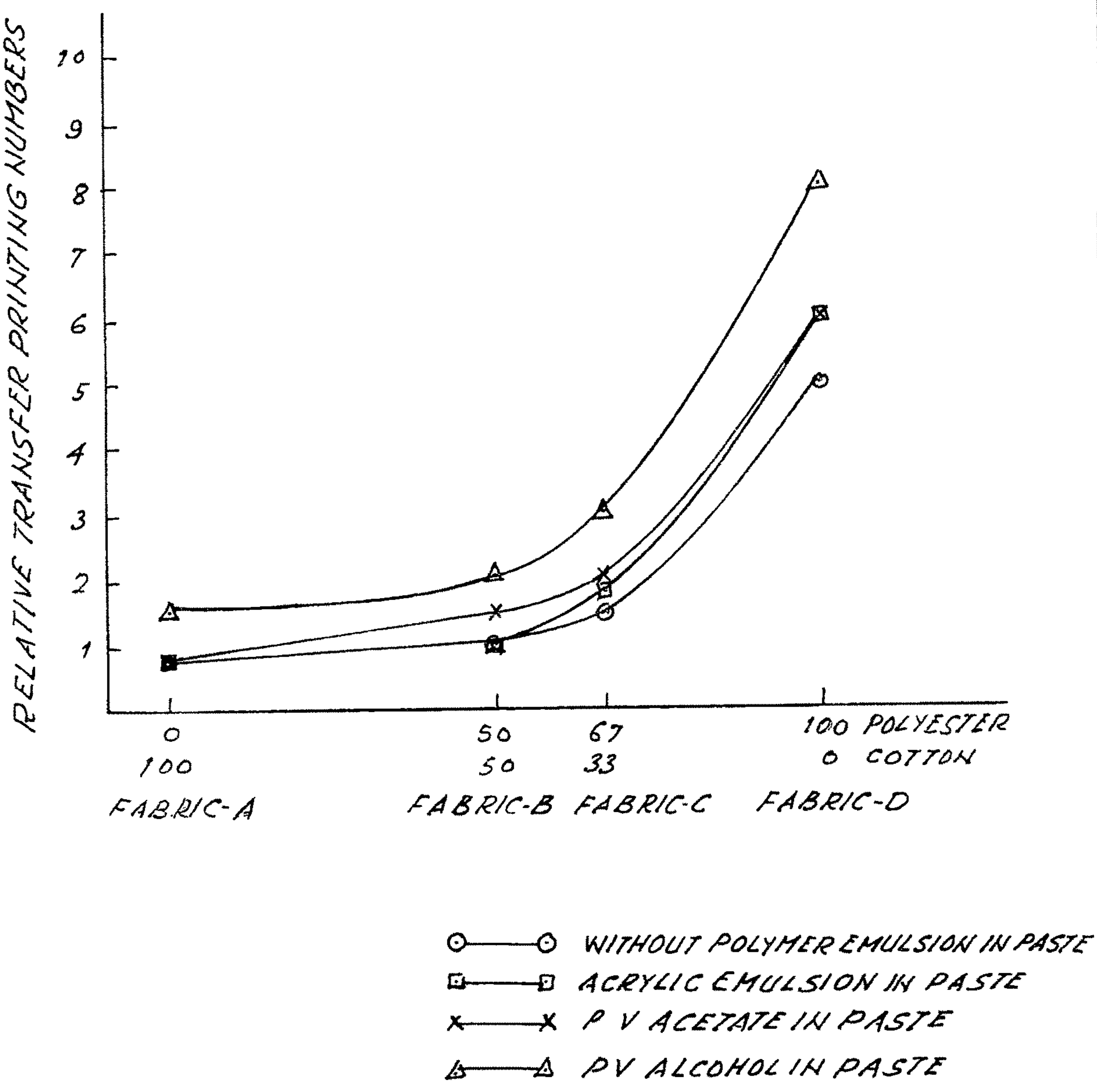
Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Po/Fo	P1/Fo	P2/Fo	P3/Fo
A	-	100	0.75	0.75	0.75	1.5
B	50	50	1	1	1.5	2
C	67	33	1.5	1.75	2	3
D	100	-	5	6	6	8

COT : Cotton.
PE : Polyester.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion (5%).
P2 : Paste with polyvinyl acetate (5%).
P3 : Paste with polyvinyl alcohol (5%).
Fo : Unfinished fabrics.
Transfer printed samples on pages 169-172

100 percent cotton printed by paste with polyvinyl alcohol and 67:33 polyester:cotton printed by paste without any synthetic polymer emulsion showed the same relative transfer printing number. From all the three synthetic polymer emulsions used polyvinyl alcohol showed the influence for increasing the transfer printing ability of all the fabrics.

The results of dye III showed that the synthetic polymer emulsion when used either as a finish on the fabric or as a paste it improved to some extent the transfer print ability but not comparable to that of dye I and dye II.

FIG. 14 INFLUENCE OF VARYING SYNTHETIC POLYMER EMULSIONS IN PASTE ON THE TRANSFER PRINTING ABILITY OF DYE-III FOR DIFFERENT FABRICS



TRANSFER PRINTED SAMPLES
OF COTTON FABRICS UNFINISHED (Fo) - DYE III

P_0

P_1

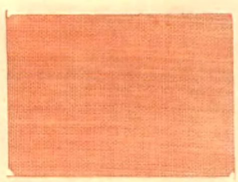
P_2

P_3

TRANSFER PRINTED SAMPLES
OF COTTON FÁBRICS FINISHED WITH ACRYLIC
EMULSION (F1) - DYE III

P_0

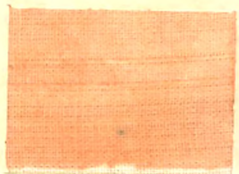
P_1



P_2

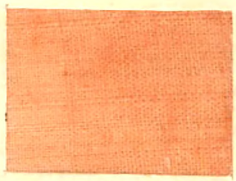
P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS UNFINISHED
(Fo) - DYE III

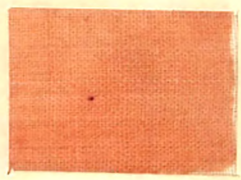


P_0

P_1



P_2



P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS FINISHED
WITH ACRYLIC EMULSION (F1) - DYE III

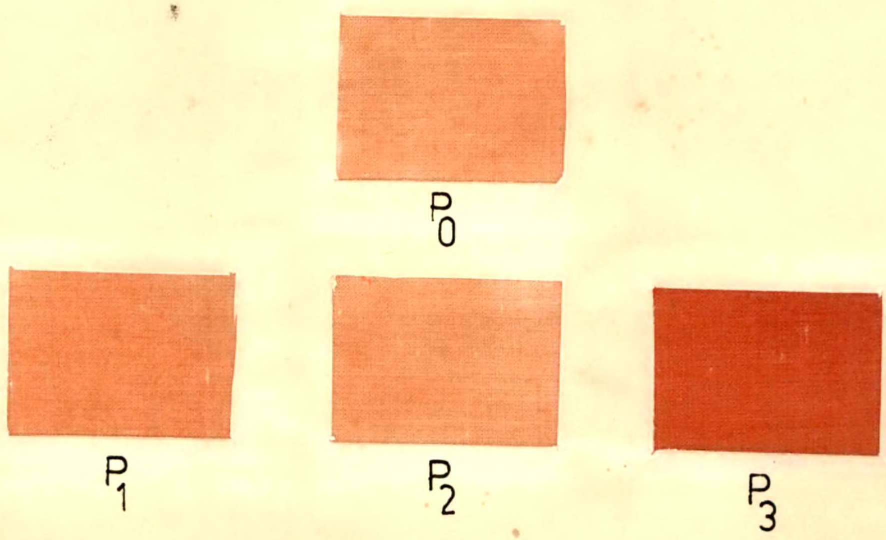
P_0

P_1

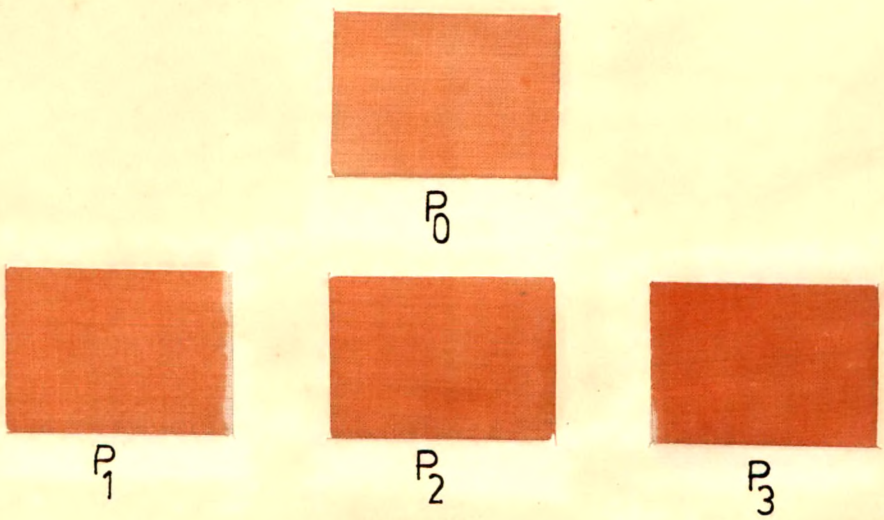
P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS UNFINISHED
(Fo) - DYE III



TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS FINISHED
WITH ACRYLIC EMULSION (F1) - DYE III



TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS UNFINISHED (Fo) - DYE III

P_0

P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS FINISHED WITH
ACRYLIC EMULSION (F1) - DYE III

P_0

P_1

P_2

P_3

In dye I and dye II, when the synthetic polymer emulsion was used as finish/paste combination gave increased transfer printability. So in dye III, improvement of the transfer printing ability was attempted by using the synthetic polymer emulsion as a finish/paste in combination, the results of which have been given in the following sub-section (iii).

iii. The influence of the combined use of synthetic polymer emulsion as a finish and in the paste on the transfer printing ability of different fabrics.

The data on the transfer printing ability of fabrics, by the combined use of each of the three synthetic polymer emulsion as a finish and in the paste on the transfer printing ability of different fabrics have been given in Table 16 to 18 and figures 15 to 17.

a. The data in Table 16 and Figure 15 are for the fabrics finished with acrylic emulsion and printed with three different pastes each containing one polymer emulsion and with a paste without any synthetic polymer emulsion.

Table 16. Data on relative transfer printing number of fabrics finished by acrylic emulsion (F1) having varying fiber content printed with varying contents in paste.

Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Po/F1	P1/F1	P2/F1	P3/F1
A	-	100	1.5	2.5	2.5	3
B	50	50	2	3	3	3.5
C	67	33	2.5	3.25	3.25	4
D	100	-	5	6	6	8

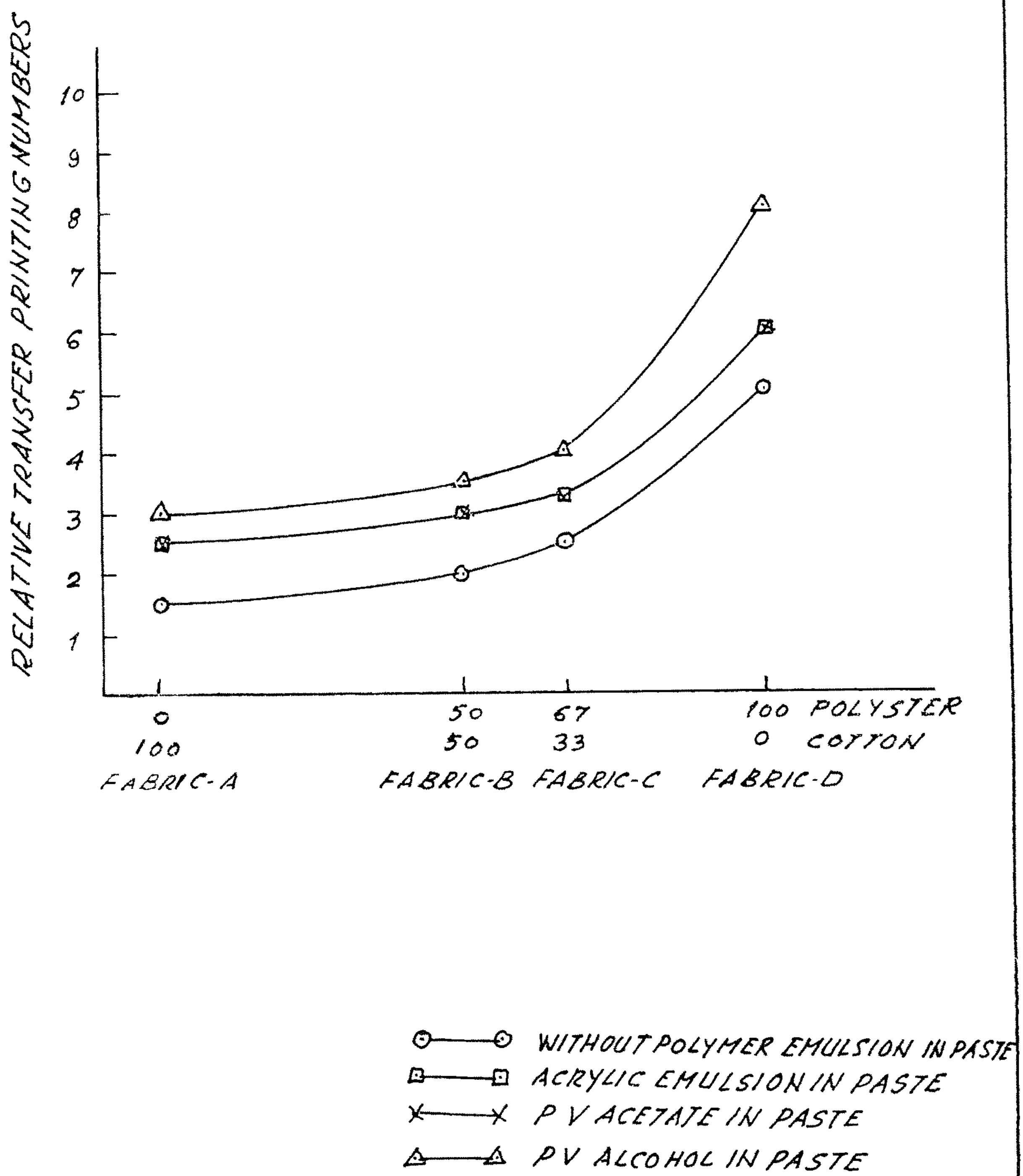
COT : Cotton.
PE : Polyester.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.
F1 : Finished with acrylic emulsion.

Transfer printed samples on pages 169-172

The comparison of the data on the finished fabrics printed with paste without any synthetic polymer emulsion and with paste containing synthetic polymer emulsions showed that the transfer printing ability of all the fabrics increased when printed with pastes containing synthetic polymer emulsion.

100 percent cotton acrylic finished printed with paste containing polyvinyl alcohol and 50:50 polyester cotton acrylic finished printed with paste containing polyvinyl acetate and acrylic emulsion showed the same relative transfer number.

FIG. 15 INFLUENCE OF FINISH (ACRYLIC) ON FABRIC AND VARYING SYNTHETIC POLYMER EMULSION IN PASTE ON TRANSFER PRINTING ABILITY OF DYE-III FOR DIFFERENT FABRICS



(b) The data on the transfer printability of the fabrics finished with polyvinyl acetate and printed with three different pastes, each containing one synthetic polymer emulsion and with a paste not containing synthetic polymer emulsion has been given in Table 17 and Figure 16.

Table 17. Data on relative transfer printing number of fabrics finished by polyvinyl acetate (F2) having varying fiber content printed with varying content in paste.

Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Po/F2	P1/F2	P2/F2	P3/F2
A	-	100	1.5	2	2	3
B	50	50	2	3	3	4
C	67	33	2.5	3.25	3.25	4.5
D	100	-	5	6	6	8

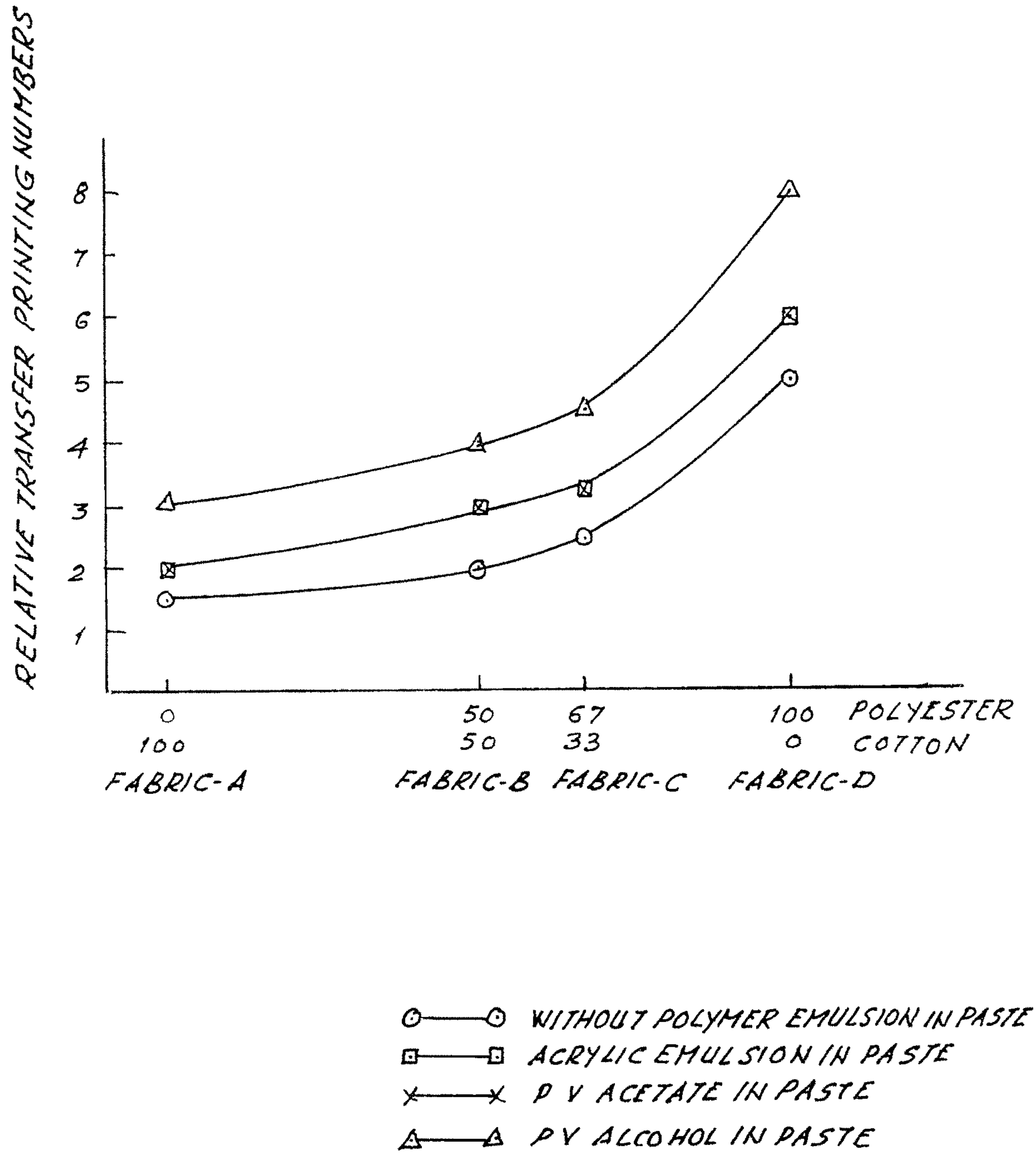
COT : Cotton.
PE : Polyester.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.
F2 : Finished with polyvinyl acetate.

Transfer printed samples on pages 178-180

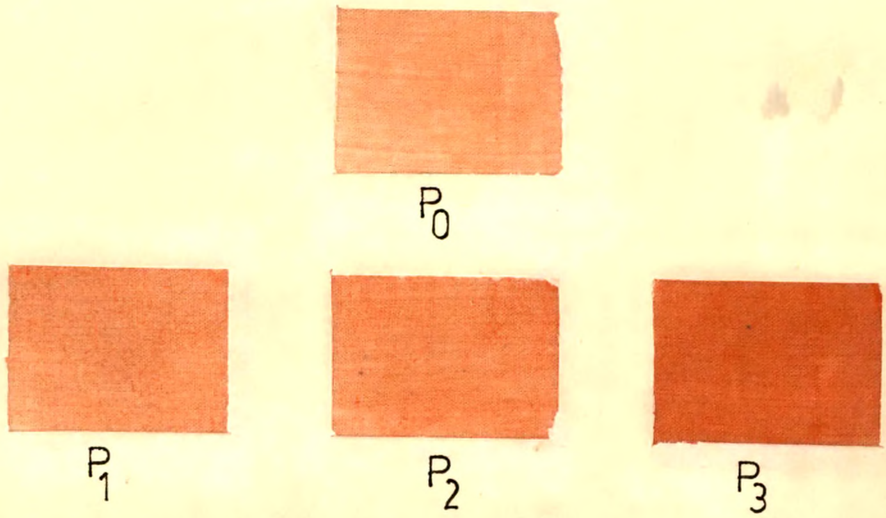
The results showed a similar trend to that of fabrics finished with acrylic emulsion, as explained in (a) above.

(c) The data presented in Table 18 and Figure 17 showed the transfer printing ability of fabrics finished with polyvinyl

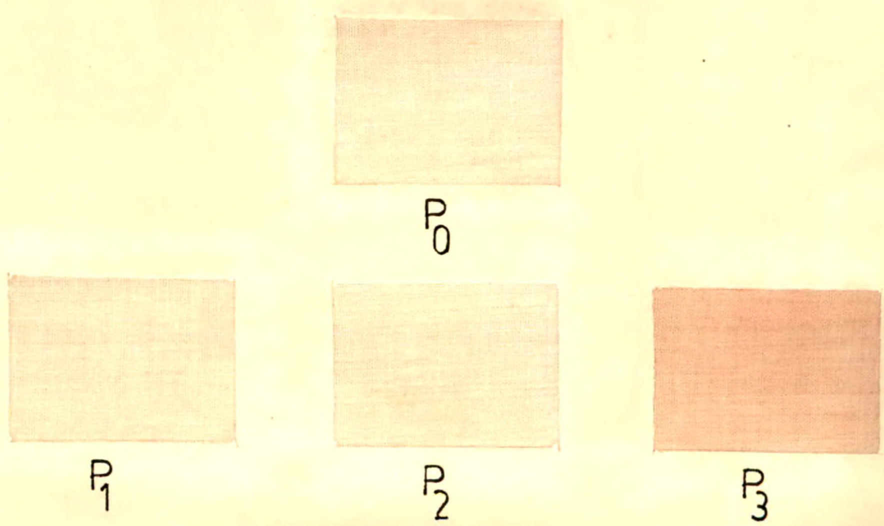
FIG. 16 INFLUENCE OF FINISH (P V ACETATE) ON FABRIC AND VARYING SYNTHETIC POLYMER EMULSION IN PASTE ON TRANSFER PRINTING ABILITY OF DYE-III FOR DIFFERENT FABRICS



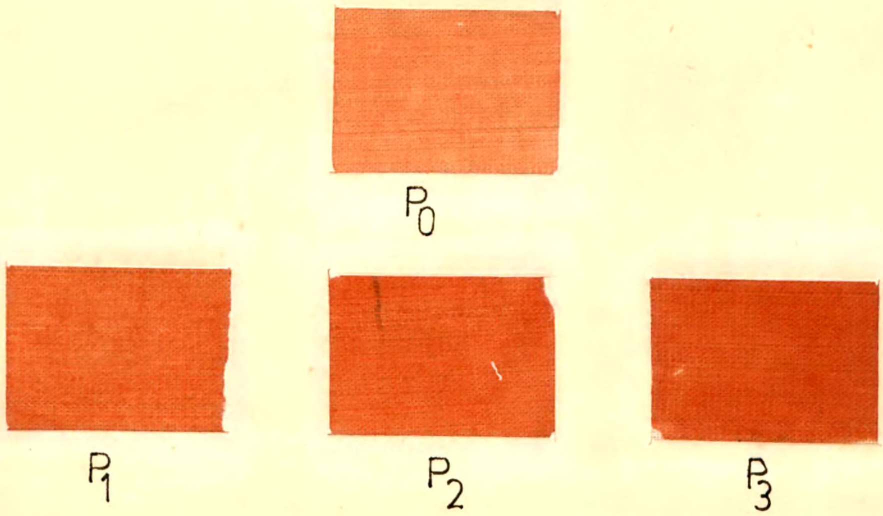
TRANSFER PRINTED SAMPLES
OF COTTON FABRICS FINISHED WITH
PV ACETATE (F2) - DYE III



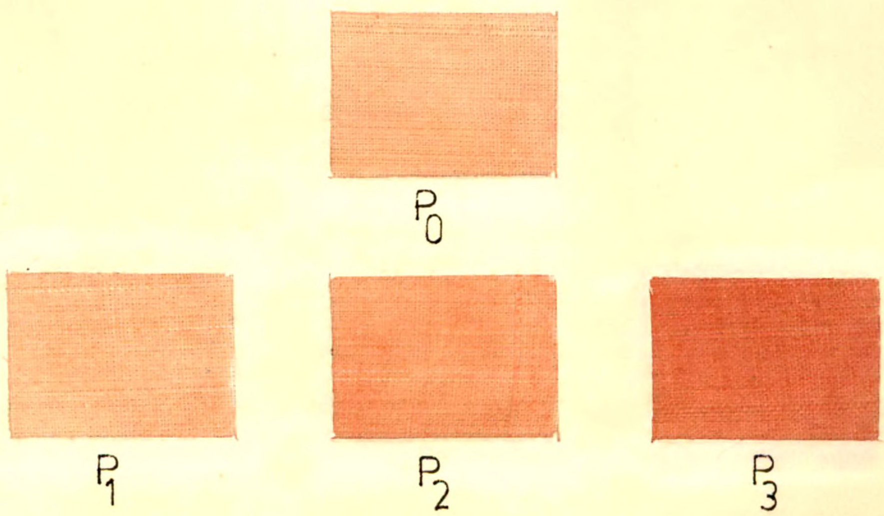
TRANSFER PRINTED SAMPLES
OF COTTON FABRICS FINISHED WITH
PV ALCOHOL (F3) - DYE III



TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS FINISHED
WITH PV ACETATE (F2) - DYE III



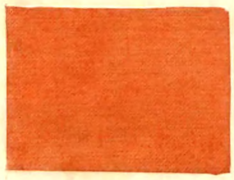
TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (50:50) FABRICS FINISHED
WITH PV ALCOHOL (F3) - DYE III



TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRICS FINISHED
WITH PV ACETATE (F2) - DYE III

P_0

P_1



P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER COTTON (67:33) FABRIC FINISHED
WITH PV ALCOHOL (F3) - DYE III

P_0

P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS FINISHED WITH
PV ACETATE (F2) - DYE III

P_0

P_1

P_2

P_3

TRANSFER PRINTED SAMPLES
OF POLYESTER FABRICS FINISHED WITH
PV ALCOHOL (F3). - DYE III

P_0

P_1

P_2

P_3

alcohol and printed with three different pastes each containing a synthetic polymer emulsion.

The results showed that all the polyvinyl alcohol finished fabrics had increased transfer printability when printed with paste containing polyvinyl alcohol as compared to the corresponding fabrics printed with paste not containing synthetic polymer emulsion.

Table 18. Data on relative transfer printing number of fabrics finished by polyvinyl alcohol having varying fiber content printed with varying contents of the paste.

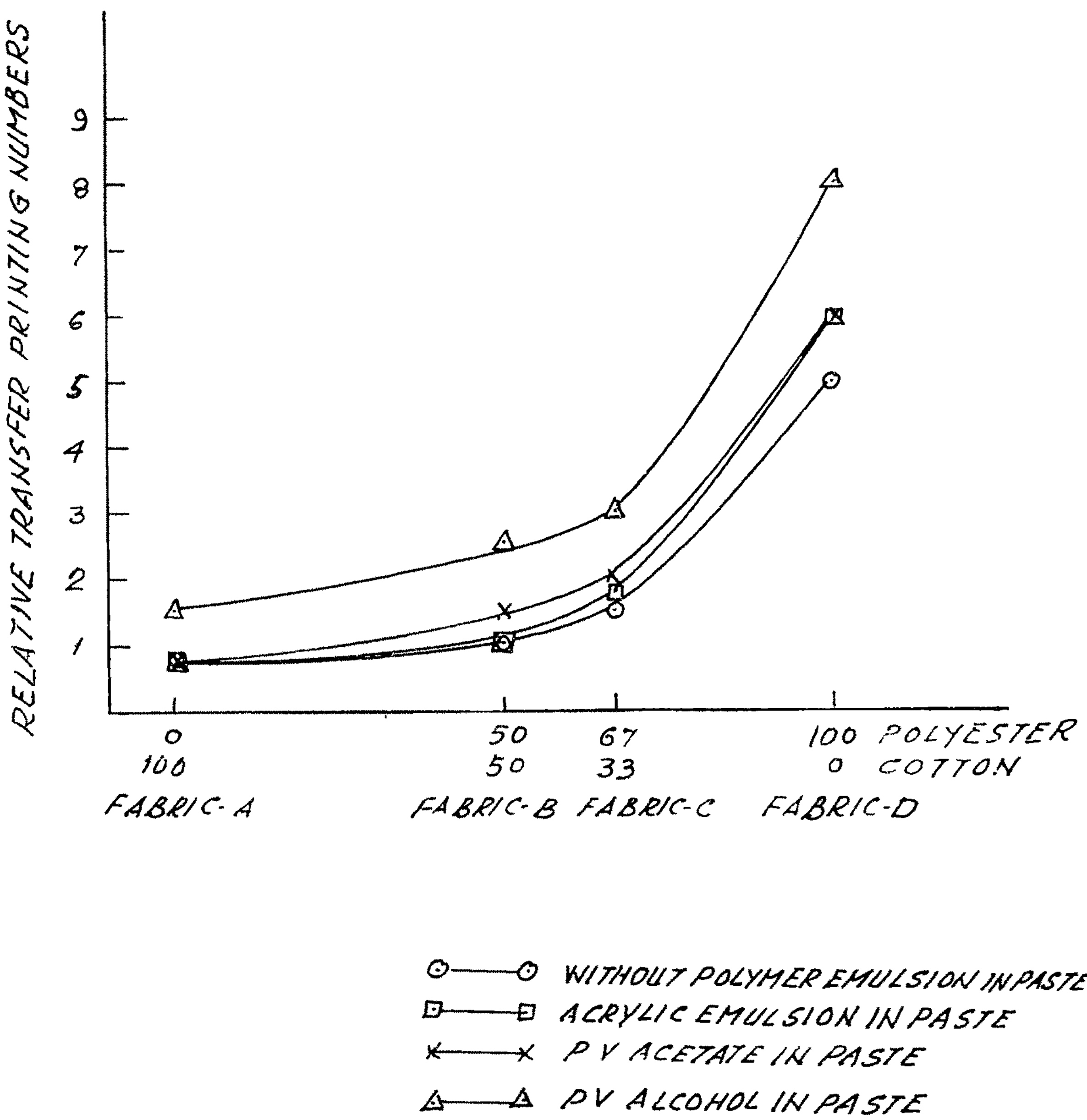
Fabric code	% Fiber Content		Relative transfer printing numbers			
	PE	COT	Po/F3	P1/F3	P2/F3	P3/F3
A	-	100	0.75	0.75	0.75	1.5
B	50	50	1	1	1.5	2.25
C	67	33	1.5	1.75	2	3
D	100	-	5	6	6	8

COT : Cotton.
PE : Polyester.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.
F3 : Finished with polyvinyl alcohol.

Transfer printed samples on pages 178-181

Pastes containing acrylic emulsion and polyvinyl acetate

FIG. 17 INFLUENCE OF FINISH (P V ALCOHOL) ON FABRIC AND VARYING SYNTHETIC POLYMER EMULSION IN PASTE ON TRANSFER PRINTING ABILITY OF DYE-III FOR DIFFERENT FABRICS



did not much help in increasing the transfer printability for all fabrics except 100 percent polyester.

The results showed that the polyvinyl alcohol when used as a finish could not increase the transfer printing ability of fabrics even though the pastes used contained synthetic polymer emulsion; this was more so in this dye III as it had a higher sublimation fastness than dye I and dye II.

The relative transfer printing ability of 100 percent cotton and its blends with polyester printed with paste containing synthetic polymer emulsion was not the same as 100 percent polyester printed with paste without a synthetic polymer emulsion, as was seen in the results of dye I and dye II. Such a result was seen as the sublimation fastness of dye III was higher than that of dye I and dye II.

The relative transfer printing ability of all the fabrics was lower in dye III when compared to the results of dye I and dye II. The samples of the fabrics finished with acrylic emulsion and printed with paste containing polyvinyl alcohol were checked for their durability to washing to see dye retention of this dye having a higher sublimation fastness.

Durability of prints to mild soap washing for dye III

The samples were washed in mild soap and dye retention after washing was assessed with standards and compared with those values before washing. These are given in Table 19 and Figure 18.

Table 19. Durability of the transfer printed samples to mild soap washing for dye III.

Finish / Fabric	Fo Before Washing	Fo After Washing	F1 Before Washing	F1 After Washing
A	1.5	-	3	0.75
B	2	1	3.5	2
C	3.0	2.75	6	5
D	8	8	8	8

Fo : Unfinished.

F1 : Finished with acrylic emulsion.

The results showed that untreated 100 percent cotton and its blends with polyester showed loss of colour after washing, whereas 100 percent polyester showed no loss of colour. Colour retention for 100 percent cotton after washing was nil or little.

The polyester content of the fabric and also the finish cotton helped in colour retention. For the finished fabrics, the colour retention improved for polyester:cotton blends.

Unfinished 100 percent cotton fabrics showed no colour retention on washing as cotton was not much receptive to the disperse dye or the dye has been superficially deposited, which washed out. The application of finish did help to increase the dye retention as the finish helped the dye penetration resulting in better dye retention.

FIG. 18 DURABILITY OF THE TRANSFER PRINTED SAMPLES TO MILD SOAP WASHING - DYE-III

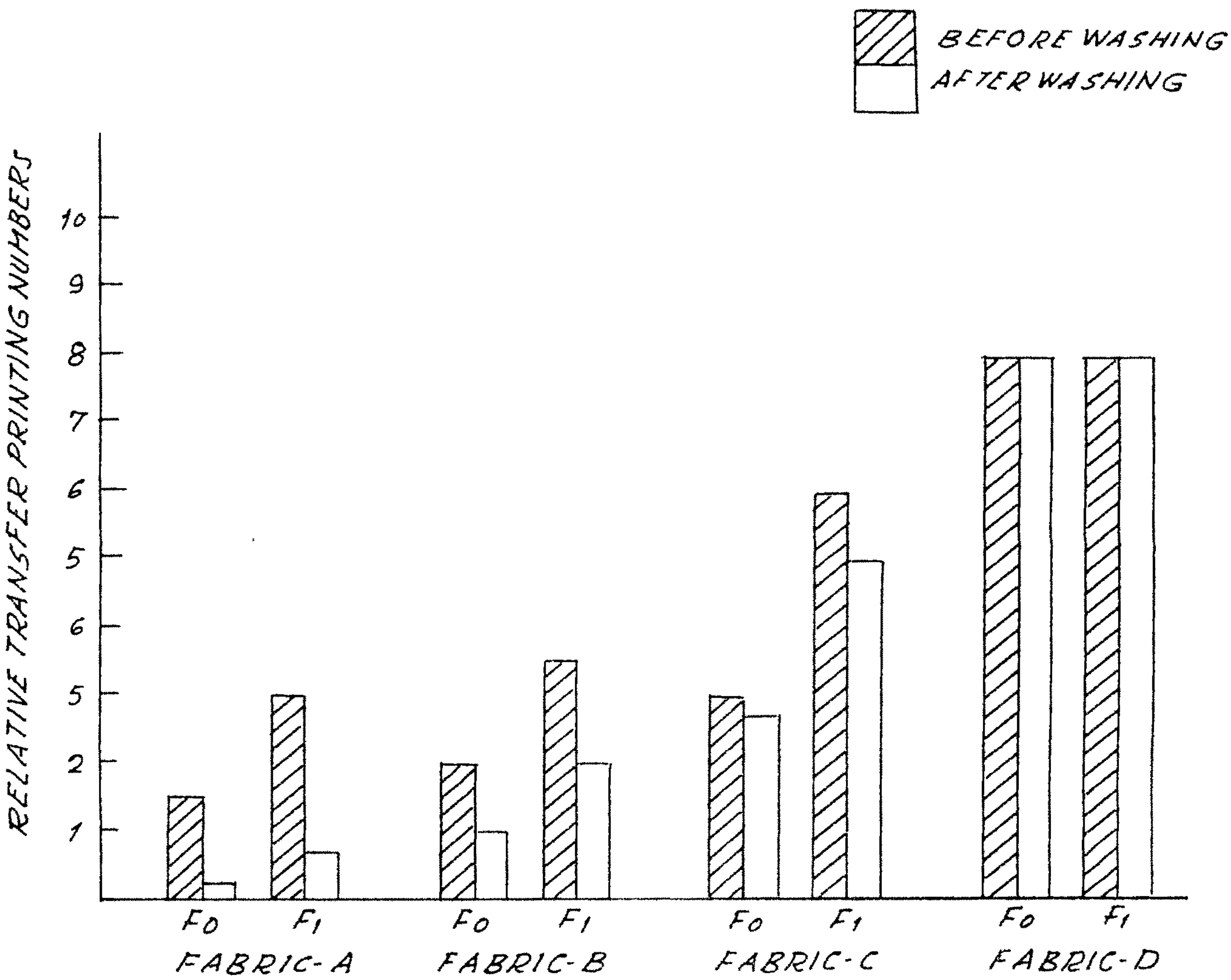


Table 20. Statistical analysis of the relative transfer printing numbers of dye I for fabric A (100 per-cent cotton).

Paste \ Finish	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	2	7	9	3	21	143
P1	2.5	9	9.5	5	26	202.50
P2	4.0	11	9.5	5	29.5	252.25
P3	6	13	12.5	8	39.5	425.25
Xj	14.5	40	40.5	21	116.0	
$\sum_i x^2_{ij}$	62.25	420	417.75	123		1023

Analysis of variance

	df	SS	MS	F
Finish	r - 1 = 3	131.8	43.9	91.45
Paste	t - 1 = 3	45.8	15.2	31.66
Error	(r-1)(t-1) = 9	4.4	0.48	
Total	rt - 1 = 15	182.0		

Fo : Unfinished fabrics.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.

Table 21. Statistical analysis of the relative transfer printing numbers of dye I for fabric B (50:50 Polyester:cotton).

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	5	8	9.5	8	30.5	243.25
P1	6	13	12.5	9	40.5	442.25
P2	9	14	13	9.5	45.5	536.25
P3	10	16	16	10	52	712.00
Xj	30	51	51	36.5	168.5	
$\sum_i x^2_{ij}$	242	685	671.5	335.25		1933.75

Analysis of variance

	df	SS	MS	F
Finish	r - 1 = 3	84.06	28.02	18.68
Paste	t - 1 = 3	61.68	20.56	13.70
Error	(r-1)(t-1) = 9	13.51	1.5	
Total	rt - 1 = 15			

Fo : Unfinished fabrics.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.

Table 22. Statistical analysis of the relative transfer printing numbers of dye I for fabric C (67:33 polyester:cotton)

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j X^2 ij$
Po	9	9.5	10	9	37.5	352.25
P1	10	14	13	12	49	609
P2	12	16	15	14	57	821
P3	16	18	18	16	68	1160
Xj	47	57.5	56	51	211.5	
$\sum_i X^2 ij$	581	866.25	818	677		2942.25

Analysis of variance

	df	SS	MS	F
Finish	(r - 1)= 3	17.30	5.76	10.66
Paste	(t - 1)= 3	124.30	41.43	76.72
Error	(r-1) (t-1) = 9	4.89	0.54	
Total	rt - 1 = 15			

Fo : Unfinished fabrics.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.

Table 23. Statistical analysis of the relative transfer printing numbers of dye I for fabric D (100 percent polyester).

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	10	10	10	10	40	400
P1	20	20	20	20	80	1600
P2	20	20	20	20	80	1600
P3	20	>20	>20	>20	80	1600
Xj	70	70	70	70	280	
$\sum_i x^2_{ij}$	1300	1300	1300	1300		5200

Analysis of variance

	df	SS	MS	F
Finish	(r - 1) = 3	0	0	0
Paste	(t - 1) = 3	300	100	∞
Error	(r-1)(t-1) = 9	0	0	
Total	rt - 1 = 15			

Fo : Unfinished fabrics.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.

Table 24. Statistical analysis of the relative transfer printing numbers of dye II for fabric A (100 percent cotton).

Paste \ Finish	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	0.75	1.4	2	1.0	5.15	7.52
P1	1.1	4	3	1.7	9.8	29.1
P2	1.4	5	6	3	15.4	71.96
P3	4	6	7	5	22.0	126
Xj	7.25	16.4	18	10.7	52.35	
$\sum_i x^2_{ij}$	19.73	78.96	98	37.89		234.58

Analysis of variance

	df	SS	MS	F
Finish	(r - 1) = 3	18.72	6.24	11.55
Paste	(t - 1) = 3	39.65	13.2	24.4
Error	(r-1)(t-1)= 9	4.93	0.54	
Total	rt - 1 = 15			

Fo = Unfinished fabrics.
F1 = Finished with acrylic emulsion.
F2 = Finished with polyvinyl acetate.
F3 = Finished with polyvinyl alcohol.
Po = Paste without a synthetic polymer emulsion.
P1 = Paste with acrylic emulsion.
P2 = Paste with polyvinyl acetate.
P3 = Paste with polyvinyl alcohol.

Table 25. Statistical analysis of the relative transfer printing numbers of dye II for fabric B (50:50 polyester:cotton).

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j X^2_{ij}$
Po	2.5	3.5	4	3	13.0	43.50
P1	4	6	5.5	4	19.5	98.25
P2	5	7	7	5	24.0	148.00
P3	6	8.5	8.5	8	31.0	244.50
Xj	17.5	25.0	25.0	20	87.5	
$\sum_i X^2_{ij}$	83.25	169.50	167.5	114		534.25

Analysis of variance

[illegible]	df	SS	MS	F
Finish	(r - 1) = 3	10.55	3.5	11.66
Paste	(t - 1) = 3	48.04	16.0	53.3
Error	(r-1) (t-1) = 9	2.85	.3	
Total	rt - 1 = 15			

Fo = Unfinished fabrics.
F1 = Finished with acrylic emulsion.
F2 = Finished with polyvinyl acetate.
F3 = Finished with polyvinyl alcohol.
Po = Paste without a synthetic polymer emulsion.
P1 = Paste with acrylic emulsion.
P2 = Paste with polyvinyl acetate.
P3 = Paste with polyvinyl alcohol.

Table 26. Statistical analysis of the relative transfer printing numbers of dye II for fabric C (67:33 polyester:cotton).

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	3	4.5	5	3.5	16.0	66.50
P1	5	7	6	5.5	23.5	140.25
P2	7	9.5	8	7.5	32.0	259.50
P3	8	10	9.5	8.75	36.25	330.81
Xj	23	31	28.5	25.25	107.75	
$\sum_i x^2_{ij}$	147	259.50	215.25	175.31		797.06

Analysis of variance

	df	SS	MS	F
Finish	(r - 1) = 3	9.3	3.1	25
Paste	(t - 1) = 3	60.97	20.3	156
Error	(r-1) (t-1) = 9	1.19	0.13	
Total	(rt - 1) = 15			

Fo = Unfinished fabrics.
F1 = Finished with acrylic emulsion.
F2 = Finished with polyvinyl acetate.
F3 = Finished with polyvinyl alcohol.
Po = Paste without a synthetic polymer emulsion.
P1 = Paste with acrylic emulsion.
P2 = Paste with polyvinyl acetate.
P3 = Paste with polyvinyl alcohol.

Table 27. Statistical analysis of the relative transfer printing numbers of dye II for fabric D (100 percent polyester)

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	8	8	8	8	32	256
P1	9	9	9	9	36	324
P2	10.5	10.5	10.5	10.5	42	441
P3	12	12	12	12	48	576
Xj	39.5	39.5	39.5	39.5	158	
$\sum_i x^2_{ij}$	399.25	399.25	399.25	399.25		1597

Analysis of variance

	df	SS	MS	F
Finish	(r - 1) = 3	0	0	0
Paste	(t - 1) = 3	37	12.3	∞
Error	(r-1)(t-1) = 9	0	0	
Total	rt - 1 = 15			

Fo : Unfinished fabrics.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.

Table 28. Statistical analysis of the relative transfer printing of dye III for fabric A (100 percent cotton).

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	0.75	1.5	1.5	0.75	4.5	5.62
P1	0.75	2.5	2	0.75	6	11.37
P2	0.75	2.5	2	0.75	6	11.37
P3	1.5	3	3	1.5	9	22.5
Xj	3.75	9.5	8.5	3.75	25.5	
$\sum_i x^2_{ij}$	3.93	23.75	19.25	3.93		50.86

Analysis of variance

	df	SS	MS	F
Finish	(r - 1) = 3	7.0	2.3	38.3
Paste	(t - 1) = 3	2.7	0.9	15
Error	(r-1)(t-1) = 9	0.56	0.06	
Total	rt - 1 = 15	10.26		

Fo : Unfinished fabrics.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.

Table 29. Statistical analysis of the relative transfer printing numbers of dye III for fabric B (50:50 polyester:cotton)

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	1	2	2	1	6	10
P1	1	3	3	1	8	20
P2	1.5	3	3	1.5	9	22.50
P3	2	3.5	4	2.5	12	38.50
Xj	5.5	11.5	12	6.0	35	91.00
$\sum_i x^2_{ij}$	8.25	34.25	38	10.5		91.00

Analysis of variance

	df	SS	MS	F
Finish	(r - 1) = 3	9.12	3.04	43.42
Paste	(t - 1) = 3	4.75	1.58	22.57
Error	(r-1)(t-1) = 9	0.63	0.07	
Total	rt - 1 = 15	14.50		

Fo : Unfinished fabrics.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.

Table 30. Statistical analysis of the relative transfer printing numbers of dye III for fabric C (67:33 polyester:cotton)

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	1.5	2.5	2.5	1.5	8	17
P1	1.75	3.25	3.25	1.75	10.0	27.24
P2	2	3.25	3.25	2	10.5	29.12
P3	3	4	4:5	3	14.5	54.25
Xj	8.25	13.0	13.50	8.25	43.0	
$\sum_i x^2_{ij}$	18.31	43.37	47.62	18.31		127.61

Analysis of variance

	df	SS	MS	F
Finish	(r - 1) = 3	6.3	2.1	105
Paste	(t - 1) = 3	5.6	1.8	90
Error	(r-1)(t-1) = 9	0.2	0.02	
Total	rt - 1 = 15			

Fo : Unfinished fabrics.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.

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Table 31. Statistical analysis of the relative transfer printing numbers of dye III for fabric D (100 percent polyester).

Finish / Paste	Fo	F1	F2	F3	Xi	$\sum_j x^2_{ij}$
Po	5	5	5	5	20	100
P1	6	6	6	6	24	144
P2	6	6	6	6	24	144
P3	8	8	8	8	32	256
Xj	25	25	25	25	100	
$\sum_i x^2_{ij}$	161	161	161	161		644

Analysis of variance

	df	SS	MS	F
Finish	(r - 1) = 3	0	0	0
Paste	(t - 1) = 3	19	6.3	∞
Error	(r-1)(t-1) = 9	0	0	
Total	rt - 1 = 15			

Fo : Unfinished fabrics.
F1 : Finished with acrylic emulsion.
F2 : Finished with polyvinyl acetate.
F3 : Finished with polyvinyl alcohol.
Po : Paste without a synthetic polymer emulsion.
P1 : Paste with acrylic emulsion.
P2 : Paste with polyvinyl acetate.
P3 : Paste with polyvinyl alcohol.

The comparison of graphical presentation in general indicated the following:

1. Influence of fiber content of the samples on the transfer printing was noted that as the polyester content increased, the transfer printing ability of the fabrics increased.

2. Influence of the presence of finish for increasing the transfer printing ability was there, for all the fabrics, but this became less with the increase in the polyester content of the fabrics.

3. Influence of synthetic polymer emulsions in the printing paste for increasing the transfer printing ability was seen for all the fabrics.

Statistical analysis for dye I, II and III

Statistical analysis of the data was done to study the combined overall effect of the synthetic polymer emulsions used as finish as well as in the paste by calculation the F values. These are given in Table Nos.20 to 31.

It was thought to varify their significance, and therefore are summarized in Table 32.

The F values of 100 percent cotton and 50:50 polyester: cotton in two dyes (dye I and Dye III) out of three show that the influence of finish was greater than the influence of

Table 32. Summary of F (calculated) values
(from tables 20 to 31).

Fabric code	PE	COT	Finish MS	Finish F	Paste MS	Paste F
<u>For Dye I</u>						
A	-	100	43.9	91.45	15.2	31.66
B	50	50	28.02	18.68	20.56	13.70
C	67	33	5.76	10.66	41.43	76.72
D	100	-	0	0	100.00	Very high
<u>For Dye II</u>						
A	-	100	6.24	11.55	13.2	24.4
B	50	50	3.5	11.66	16.0	53.3
C	67	33	3.1	23.0	20.3	156.0
D	100	-	0	0	12.3	Very high
<u>For Dye III</u>						
A	-	100	2.3	38.3	0.9	15.0
B	50	50	3.04	43.4	1.58	22.5
C	67	33	2.1	105.0	1.8	90.0
D	100	-	0	0	6.3	Very high

F Table value: Level .005, (3/9 d.f.) = 8.72
Level .010, (3/9 d.f.) = 6.99
Level .025, (3/9 d.f.) = 5.08
Level .050, (3/9 d.f.) = 3.86

MS = Mean square.
PE = Polyester.
COT = Cotton.

paste; whereas in 67:33 polyester:cotton the influence of paste is seen more than the influence of finish and in all the three dyes.100 percent polyester show that the finish has no effect and the paste has a very high effect on the transfer printing ability.

It is seen that though the F values are very high and although they cannot be directly compared with the data in the tables, and graphs, they show more or less a similar trend and confirm the following points:

1. Synthetic polymer emulsions helped to improve the transfer printing ability of the fabrics.

2. Synthetic polymer emulsions when used as a finish on the fabrics influenced the cotton but not polyester.

3. Synthetic polymer emulsions when used in the paste composition improved the transfer printing ability of all the fabrics including 100 percent polyester.

Thus it can be concluded that 100 percent cotton and its blends with polyester would show good transfer print ability if they are finished with a synthetic polymer emulsion and then printed with a paste containing synthetic polymer emulsion.