CHAPTER IV

RESULTS AND DISCUSSIONS

In this research, finishing agents Ahuracryl Tx50, an acrylic finish and superfinish EU, a dimethyloldihydroxyethyleneurea finish were applied on cotton fabric A, 67/33 polyester/cotton fabric B, polyester fabric C and 50/50 polyester/cotton fabric D. These finishes were initially used as separate finishes and later in combination. The influence of these finishes on physical properties of the treated fabrics has been reported in Part I and II; while preliminary data of fabrics being reported seperately.

Part I : Effect of Varying Concentrations of Finishes on the Physical Properties of the Treated Fabrics A, B and C.

1. Effect of varying concentrations of acrylic and DMDHEU finishes on wrinkle recovery.
2. Effect of varying concentrations of acrylic and DMDHEU finishes on tensile strength of finished fabrics.
3. Effect of varying concentrations of acrylic and DMDHEU finishes on the percentage elongation at different loads.
4. Effect of varying concentrations of acrylic and DMDHEU finishes on appearance rating.

Part II : Effect of Varying Concentrations of Combination Finishes of Acrylic and DMDHEU on the Physical Properties of the Treated Fabrics A, B and D.

5. Effect of varying concentrations of combination finishes on wrinkle recovery.

6. Effect of varying concentrations of combination finishes on tensile strength.

7. Effect of varying concentrationsof combination finishes on the percentage elongation at different loads.

8. Effect of varying concentrations of combination finishes on appearance rating.

9. Relationship between wrinkle recovery and tensile strength at varying concentrations of finished fabrics.

Preliminary Data of Fabrics

The preliminary fabric data on fiber content, fabric count, weight per unit area and thickness have been given in Table 1. The fabric constructions were typical and fell in two general classes. Fabrics A, B and C were of relatively tight constructions, while fabric D was of relatively loose construction. All the fabrics were of medium weight, 85-116 grams per square meter. Thickness of the fabrics was also similar.

TABLE 1

PRELIMINARY DATA OF THE FABRICS

Fabric Code	Fiber content	Fabric count yarns/inch (yarns/cm) Warp	Weft	Weight per unit area oz/sq. yd. (gm/sqm)	Thickness in inch (in cm)
A	100% C	120 (48)	106 (42)	2.47 (84.800)	.003 (.012)
B	67% P 33% C	110 (44)	98 (39)	3.38 (116.0)	.004 (.010)
C	100% P	116 (46)	100 (40)	2.71 (92.800)	.004 (.010)
D	50% P 50% C	77 (31)	67 (27)	2.62 (89.6)	.008 (.020)

C = Cotton

P = Polyester

PART I

1. Effect of Varying Concentrations of Acrylic and DMDHEU Finishes on Wrinkle Recovery.

The earlier work reported by Bali and Mathur (4,29) dealt with the influence of varying concentrations (0.5, 1.0, 2.0, 4.0 and 8.0) of thermoplastic finish (acrylic finish, Ahuracryl Tx50) on wrinkle recovery, tearing strength, tensile strength etc. It has been stated that higher concentrations, like four and eight percent of the acrylic finish, did not give any progressively additive effect, nor was there any evidence of negative influence. In this study therefore fabrics were treated with thermoplastic finish (acrylic finish) and with thermosetting finish (DMDHEU) at lower concentrations. The concentrations like 0.5, 1.25, 2.0 and 2.5 percent of both the finishes and their combinations of 2.5 and 5.0 concentrations were applied on fabrics. The concentrations of these agents and so also their ratios in the combination finish were varied so that information was available from all angles.

a. Effect of Acrylic Finish on Wrinkle Recovery of Finished Fabrics.

The data on the wrinkle recovery (in degrees) of fabrics A, B and C finished with varying concentrations of acrylic finish have been shown graphically in Figures 2, 3 and 4 and given in Table 2.

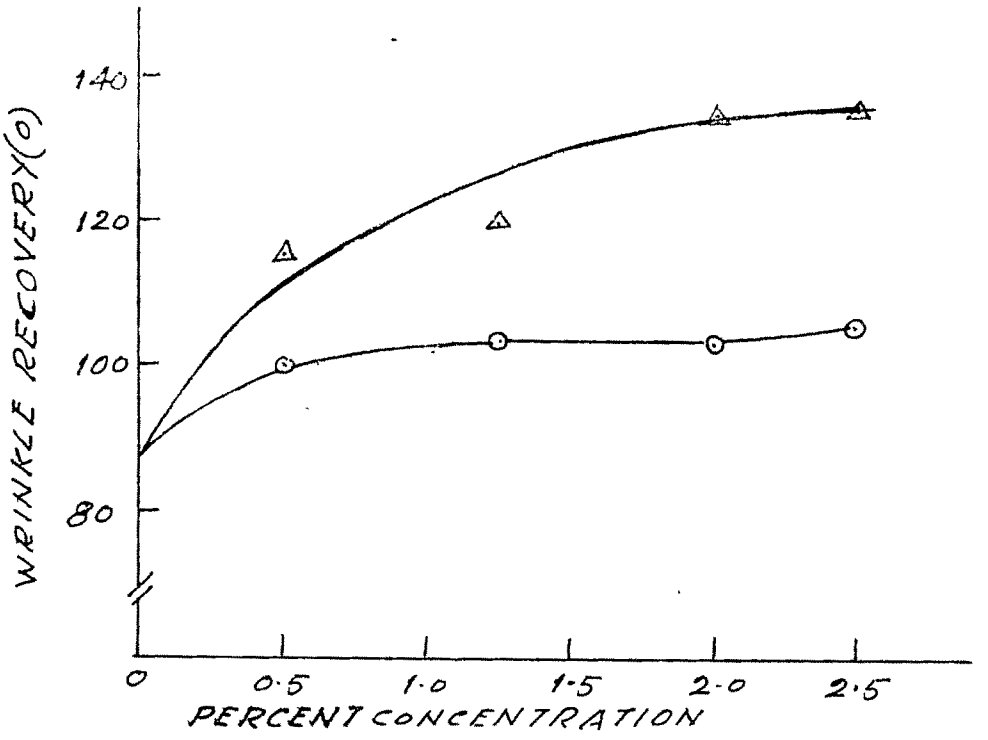
The effects of different concentrations of acrylic finish were found to improve wrinkle recovery at lower concentrations, the curves being essentially parallel to the horizontal axis after 1.25 percent concentration for cotton and polyester/cotton blend fabrics (fabrics A and B). In both the fabrics, some improvement in wrinkle recovery was observed with acrylic finish. Wrinkle recovery angle increased, though slight, with the increase in concentration of the treatments. No change was noticed with polyester fabric.

These results are in accordance with the work done by Rawls, Klein and Eyer (37) who have reported that elastomeric polymers are effective in enhancing the wrinkle recovery property of cotton fabrics. They have concluded that elasticity plays an important role in the ability of a polymer to improve wrinkle recovery. Influence of acrylic finish was therefore seen in fabrics containing cotton (A and B) and not in the polyester fabric, C.

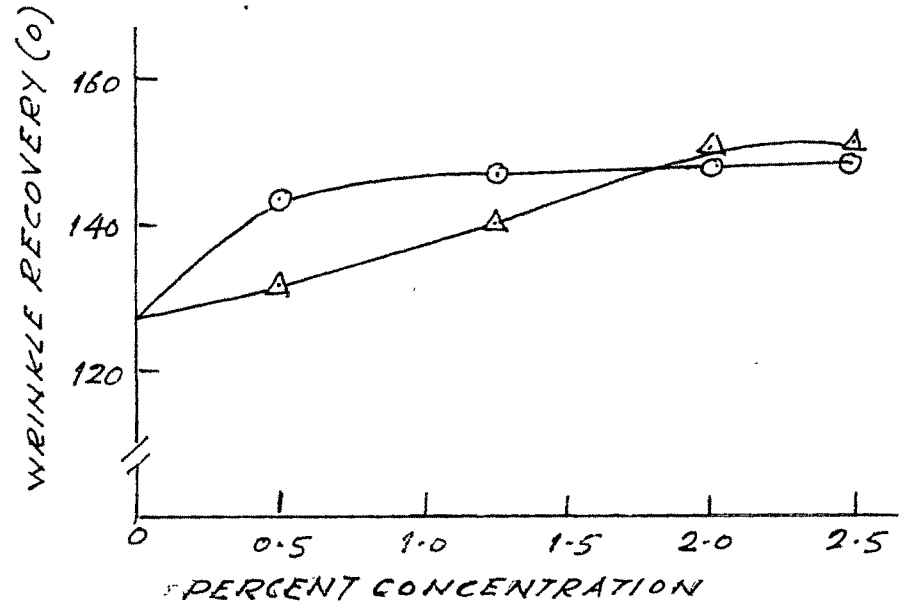
b. Effect of DMDHEU Finish on Wrinkle Recovery of Finished Fabrics.

The data on the wrinkle recovery has been illustrated graphically in Figures 2, 3 and 4. As for the effects of DMDHEU finish, the graphs steadily moved upwards, the wrinkle recovery values were stabilized after 2.0 percent concentration for cotton and polyester/cotton blend fabrics (Fabrics A and B). With DMDHEU finish, wrinkle recovery values

COTTON FABRIC A

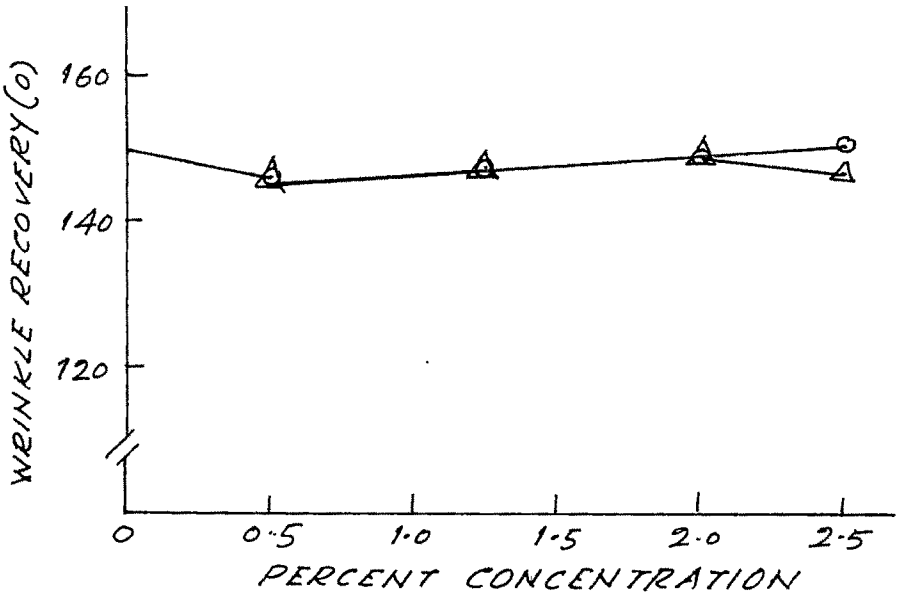


POLYESTER/COTTON FABRIC B



⊙ - ACRYLIC FINISH, △ - DMDHEU FINISH

FIG. 2 AND 3 WRINKLE RECOVERY OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS



⊙ ACRYLIC FINISH, △ DMDHEU FINISH

FIG. 4 WRINKLE RECOVERY OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS (POLYESTER FABRIC C)

TABLE 2

WRINKLE RECOVERY IN DEGREES OF FINISHED FABRICS (WARP)

AT DIFFERENT CONCENTRATIONS OF FINISHES USED

% Conc. of Finish		Fabrics	Wrinkle Recovery (°) Warp		
Acrylic	DMDHEU		A	B	C
0.5	-		100.3	143.8	145.8
1.25	-		103.7	147.4	147.8
2.0	-		103.2	148.8	149.3
2.50	-		105.5	149.0	150.5
-	0.5		115.9	132.1	146.0
-	1.25		120.1	140.8	147.8
-	2.00		135.0	151.0	149.1
-	2.5		135.1	151.1	148.5
0.5 +	2.0		135.9	151.1	151.0
1.25 +	1.25		131.3	152.1	150.1
2.0 +	0.5		124.0	150.7	150.9
Control			89.3	128.4	149.7

Fabric A : Cotton

Fabric B : 67/33 Polyester/Cotton.

Fabric C : Polyester.

increased with increasing concentration, the influence of DMDHEU finish was higher than the influence of acrylic finish for both, fabric A and B. All the values obtained were about equivalent to the normal values for polyester fabric C.

c. Effect of Combination Finish (Acrylic + DMDHEU Finish) on Wrinkle Recovery of Finished Fabrics.

Graphical representation of combination finish (Figure 5) for cotton fabric A indicated a supplementary effect, though not cumilative. Both the finishes assisted each other to improve the wrinkle recovery of the fabric. The curves for polyester/cotton blend and polyester, fabrics B and C being close and parallel indicated improvement in wrinkle recovery for fabric B to the level of wrinkle recovery of fabric C. When fabric A was treated with varying combination finishes of acrylic and DMDHEU, the wrinkle recovery values also improved. With higher proportion of DMDHEU finish the wrinkle recovery was higher. For polyester/cotton fabric B, all the three ratios of combination finishes had equivalent improvement in wrinkle recovery but finish having equal proportions of acrylic and DMDHEU finishes had a slight edge over the other combination finishes. The polyester fabric C treated with combination finishes showed no changes in wrinkle recovery over that of the original.

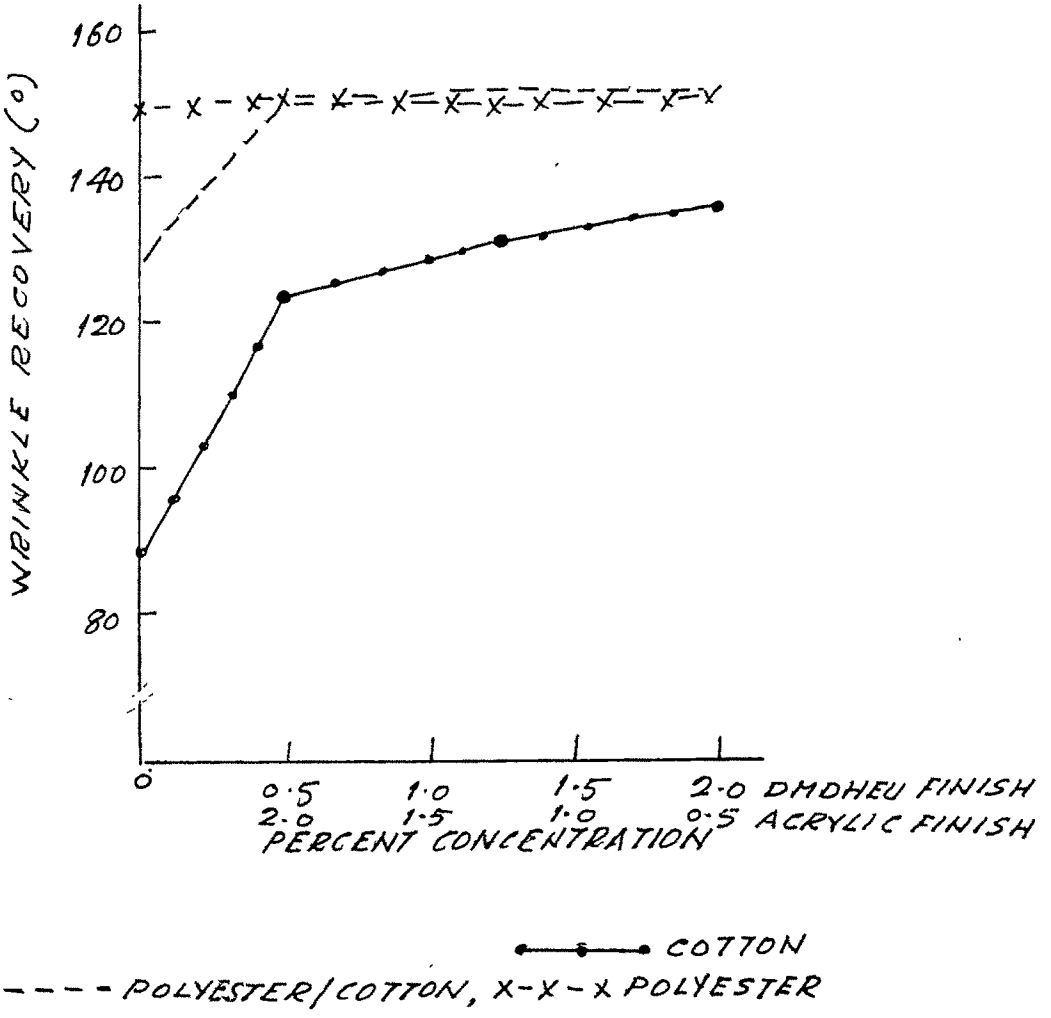


FIG. 5 WRINKLE RECOVERY OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS (COMBINATION FINISH)

2. Effect of Varying Concentrations of Acrylic and DMDHEU Finishes on Tensile Strength of Finished Fabrics.

Cellulosic fabrics are commonly finished with thermosetting resin finishes to improve properties like wrinkle recovery and crease retention. A serious drawback accompanied with the use of these materials is that they tend to weaken the fabric due to the rigidity introduced by cross-linking. Attempts have been made to reduce the drawback to some extent by addition of lubricating agents like waxes, acrylates, acetates etc. In this research work, the combination of thermoplastic (acrylic) and thermosetting (DMDHEU) finishes were tried primarily to see whether the thermoplastic finish, as a major component, could overcome not only the detrimental effect but also be further beneficial for the polyester/cotton blend fabrics also.

The tensile strength and elongation were studied at different concentrations of the finishes and on the three fabrics, namely, cotton fabric A, polyester/cotton fabric B and polyester fabric C. The data on tensile strength (in lbs.) in warp direction of fabrics A, B and C with varying concentrations of finish have been given in Table 3 and also illustrated in Figures 6 to 9.

(a) Effect of acrylic finish on tensile strength of finished fabrics: The graphical representation of the data (Figure 6) for cotton fabric A treated with acrylic

finish showed stabilization at 0.5 percent level of concentration, followed by an increase of highest level at 1.25 percent after which at higher concentration tensile strength decreased with increase in concentration, though the strength was noticed to be above the original towards the end.

The curves (Figure 7) for polyester/cotton blended fabric B moved steadily upward when treated with acrylic finish, indicating a little increase in tensile strength with increase in concentration of the finish.

Polyester fabric C treated with acrylic finish showed no appreciable change in tensile strength.

The explanation for the increase in strength can be due to the presence of acrylic finish which helped the bonding forces in amorphous portions of cellulose and did not cause rigidity due to their nature. Less of amorphous region in polyester in turn, caused little change.

(b) Effect of DMDHEU finish on tensile strength of finished fabrics: The effect of DMDHEU finish shown in Figures 6, 7 and 8 was seen to be different from that of acrylic finish. A downward curve showed a high level decrease in strength with increase in concentration of the finish for cotton fabric A. Similar trend was noticed with polyester/cotton fabric B but the loss in strength was less. With polyester fabric C, changes were slight with DMDHEU finish. Loss in strength was associated with polymerization or cross-linking.

TABLE 3

TENSILE STRENGTH IN Lbs OF FINISHED FABRICS (WARP) AT DIFFERENT CONCENTRATIONS OF FINISHES USED

% Conc. of Finish		Fabrics	Tensile Strength in lbs.(Warp)		
Acrylic	AMDHEU		A	B	C
0.5	-		35.0	39.0	40.2
1.25	-		40.3	39.5	42.0
2.0	-		38.9	41.2	43.1
2.5	-		37.0	41.2	43.0
-	0.5		23.3	36.0	40.6
-	1.25		22.0	35.4	39.4
-	2.0		21.0	34.4	41.4
-	2.5		18.5	32.4	40.0
0.5 +	2.0		24.6	37.2	40.2
1.25 +	1.25		28.8	42.2	40.0
2.0 +	0.5		29.2	40.0	42.0
Control			35.2	39.1	42.0

Fabric A : Cotton.

Fabric B : 67/33 Polyester/Cotton.

Fabric C : Polyester.

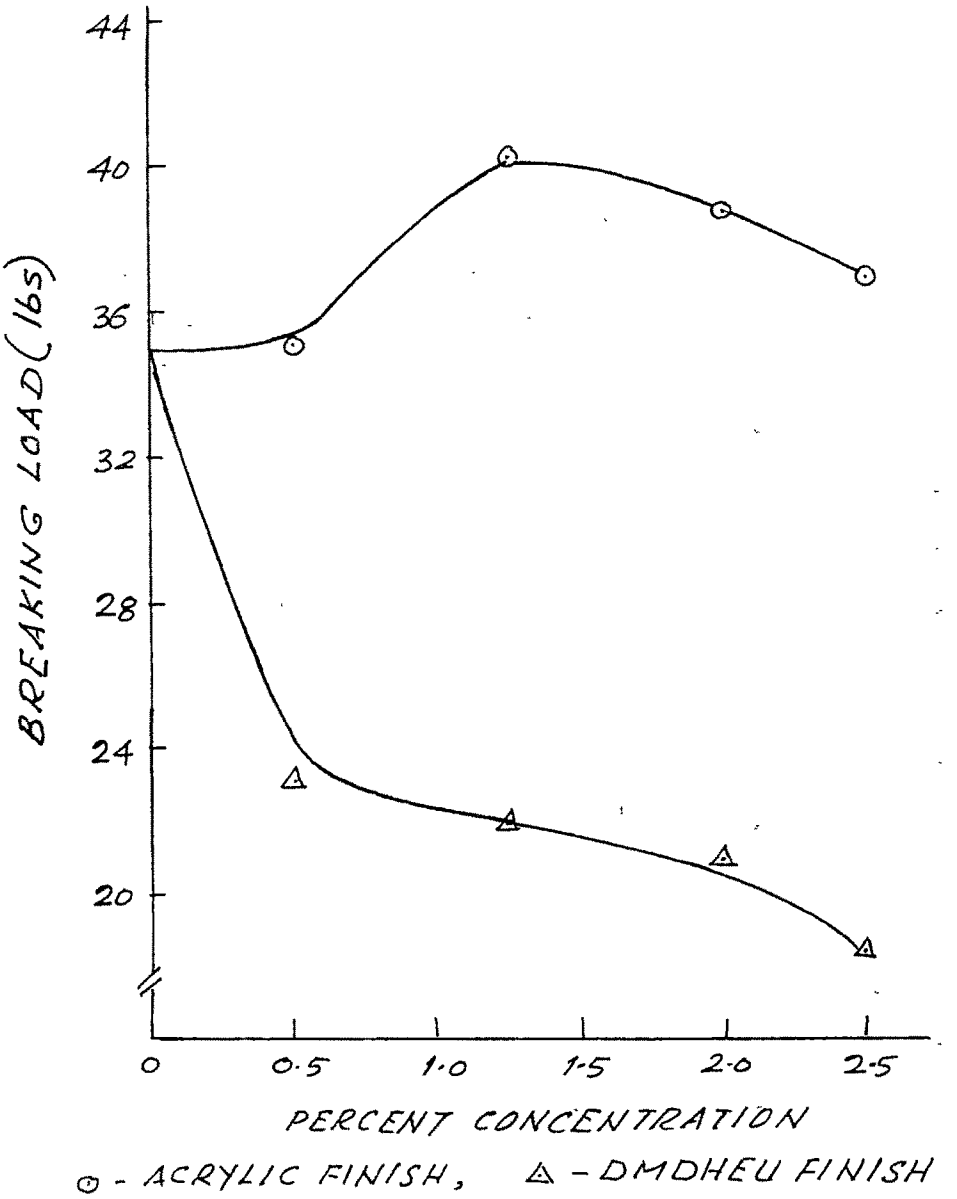
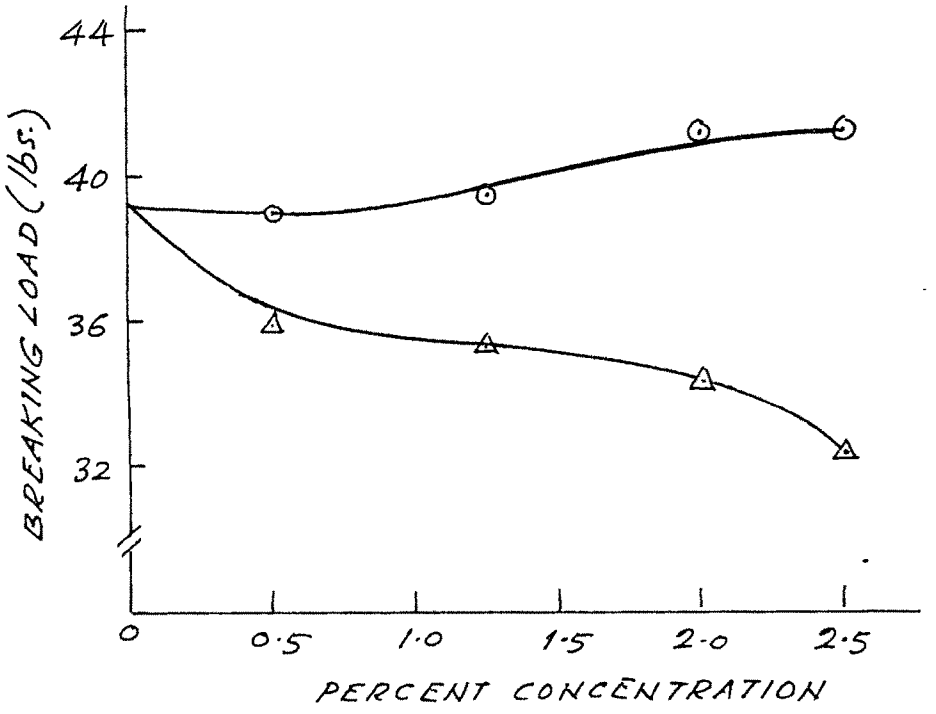
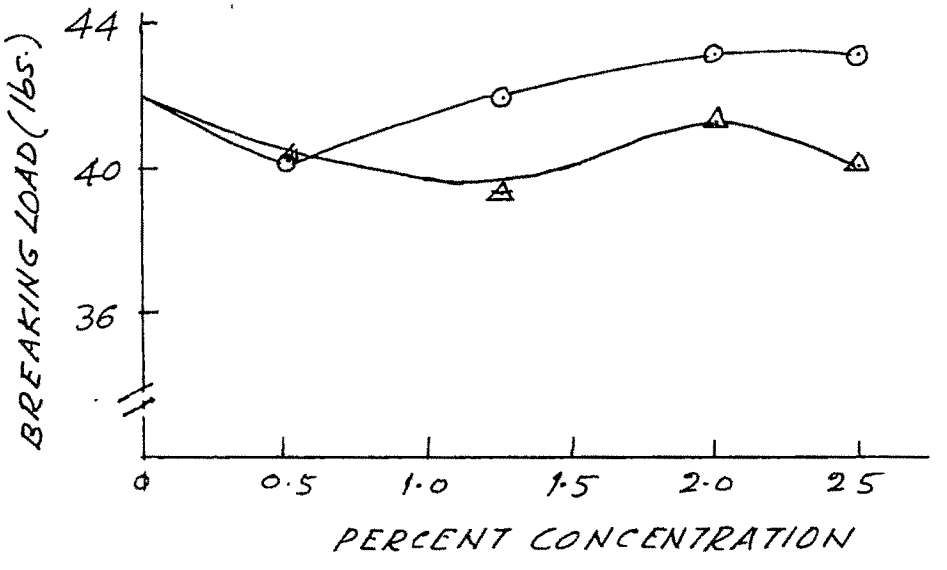


FIG. 6 TENSILE STRENGTH OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS (COTTON FABRIC A)

POLYESTER COTTON FABRIC B



POLYESTER FABRIC C



⊙ - ACRYLIC FINISH, △ - DMDHEU FINISH

FIG.7-8 TENSILE STRENGTH OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS

(c) Effect of combination finish (acrylic + DMDHEU finish) on tensile strength of finished fabrics: The data on the tensile strength of combination finish is shown in Figure 9. With the combination finish of acrylic and DMDHEU the loss in strength was minimized for cotton fabric A as compared to the DMDHEU finished cotton fabric. With greater or same proportion of acrylic to DMDHEU finish the tensile strength results were comparatively better. Polyester/cotton fabric B when treated with combination finish showed an increase in tensile strength, specially with finishes having equal or more percentage of thermoplastic finish component. Equal proportion of both the finishes showed maximum increase in tensile strength. With polyester fabric C, little change in strength was noticed with greater or equal proportion of DMDHEU to acrylic finish.

3. Effect of Varying Concentrations of Acrylic and DMDHEU Finishes on the Percentage Elongation at Different Loads.

The comparison of the effect of concentrations of the finishes on the three fabrics was also extended to the percentage elongation at various intermediate loads. From the automatic record obtained on the Scott Tester, the elongation at intermediate loads (5, 10, 20, 30, 40 lbs) was obtained and converted to percentage elongation. The data on the percentage elongation at different loads for the three fabrics

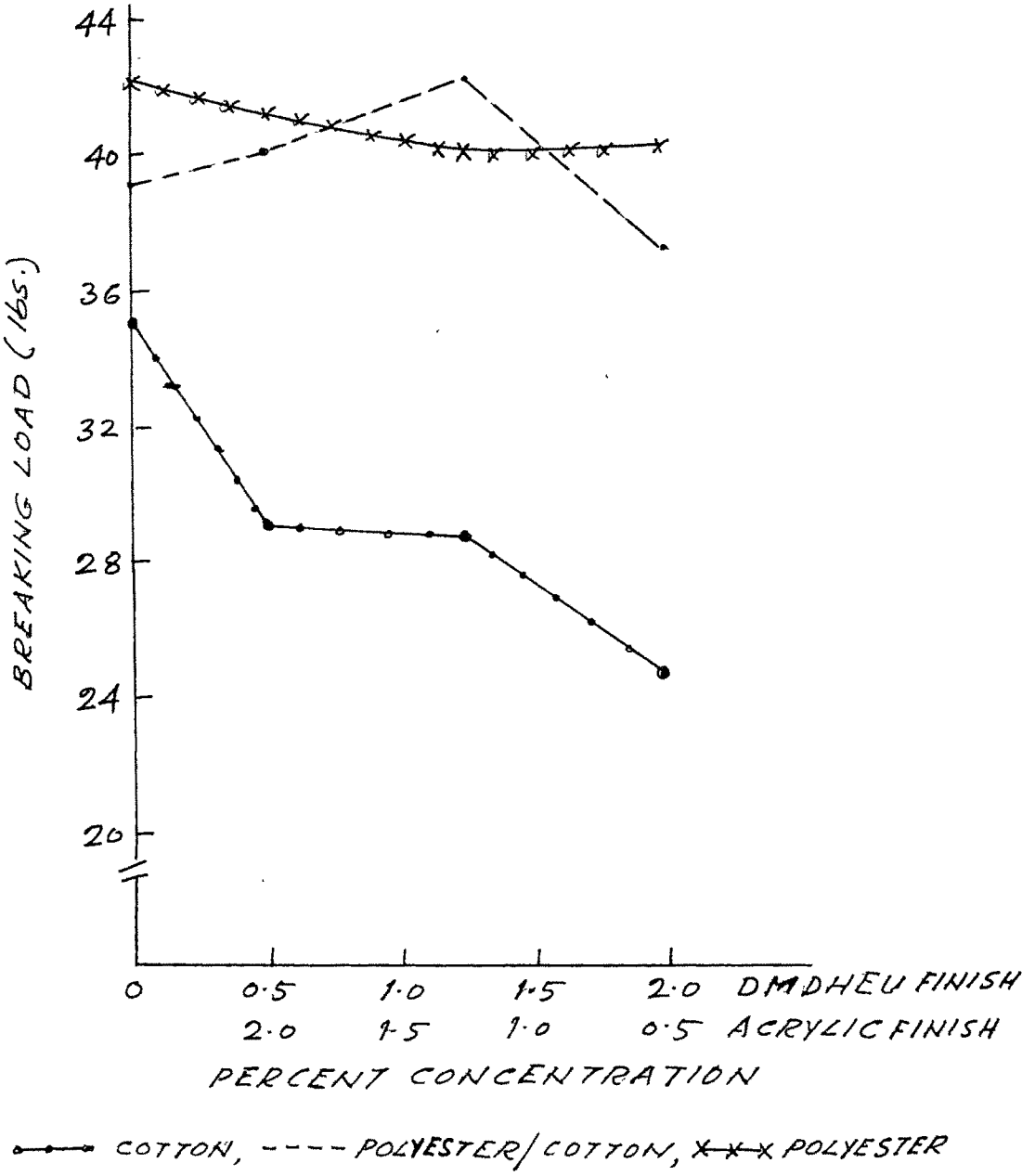


FIG. 9 TENSILE STRENGTH OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS (COMBINATION FINISH)

(A, B and C) finished with varying concentrations of finishes have been given in Tables 4, 5 and 6 and graphically represented in Figures 10 to 18.

(a) Effect of acrylic finish on the percentage elongation at different loads: A comparison of these graphs for cotton fabric A (Figure 10) indicated very small changes in the nature of graphs. The analysis of the data revealed that in case of cotton fabric A, graph with concentration 0.5 percent of acrylic finish was almost on the similar line of the original and a part of the graph of 1.25 percent was higher with higher elongation. The graph for 2.0 percent of acrylic finish follows the same pattern as control but has more elongation at breaking point whereas the graph for 2.5 percent was lower than that of the original. This is in consonance with the results of Mathur (29) that the graphs for cotton fabric were very close upto 1 percent of acrylic finish while those at 4 percent and 8 percent were lower than at 0 level. However, the percentage elongation at breaking point for all the treatments of acrylic finish was somewhat higher indicating that regidity was not introduced with acrylic finish.

The graphs for fabric B, treated with acrylic finish (Figure 13) were very close to the original and for fabric C the graphs with all the concentrations of acrylic finish (Figure 16) were lower than the original. The higher elongation in case of fabric B and C can be explained as the influ-

TABLE 4

PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS

(COTTON FABRIC A) WARP

% Conc. of Finish		Loads (lbs)	Percentage Elongation					
Acrylic	DMDHEU		5	10	20	30	EBP	BP (lbs)
0.5	-		3.3	5.0	6.7	9.3	10.0	(35.0)
1.25	-		1.67	3.3	7.3	10.0	12.7	(40.3)
2.0	-		3.3	4.3	6.7	9.3	12.0	(38.9)
2.5	-		1.67	3.3	5.9	8.0	11.0	(37.0)
-	0.5		3.3	4.3	7.0	-	8.7	(23.3)
-	1.25		3.0	4.0	5.6	-	6.0	(20.8)
-	2.0		2.0	3.7	4.7	-	5.7	(21.0)
-	2.5		3.3	5.0	-	-	7.0	(18.5)
0.5 +	2.0		3.3	4.3	5.3	-	7.3	(24.6)
1.25 +	1.25		3.3	6.7	8.0	-	10.3	(28.8)
2.5 +	0.5		2.3	3.3	5.3	-	9.3	(29.2)
Control			3.3	4.3	6.7	9.3	10.0	(35.2)

EBP : Elongation at breaking point.

BP : Breaking point.

TABLE 5

PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS

(POLYESTER COTTON FABRIC B) WARP

% Conc. of Finish			Loads (lbs)	Percentage Elongation						
Acrylic		DMDHEU		5	10	20	30	40	EBP	BP (lbs)
0.5		-		2.3	4.0	8.7	13.0	-	19.0	(39.0)
1.25		-		2.3	4.3	8.7	13.7	-	20.0	(39.5)
2.0		-		2.3	4.3	8.7	13.7	20.0	21.7	(41.2)
2.5		-		1.7	3.3	8.0	13.3	19.3	20.3	(41.2)
-		0.5		3.3	5.0	10.3	14.0	-	22.7	(36.0)
-		1.25		3.3	5.7	10.3	16.7	-	22.0	(35.4)
-		2.0		3.3	4.0	7.3	14.0	-	20.0	(34.4)
-		2.5		3.3	5.0	10.0	15.3	-	20.0	(32.0)
0.5	+	2.0		3.3	6.0	10.7	16.3	-	21.0	(37.2)
1.25	+	1.25		3.3	5.0	9.7	15.3	22.3	23.3	(42.2)
2.0	+	0.5		3.3	5.0	9.7	16.7	23.0	23.0	(40.2)
Control				3.0	4.7	9.0	13.7	-	20.7	(39.1)

EBP : Elongation at breaking point.

BP : Breaking point.

TABLE 6

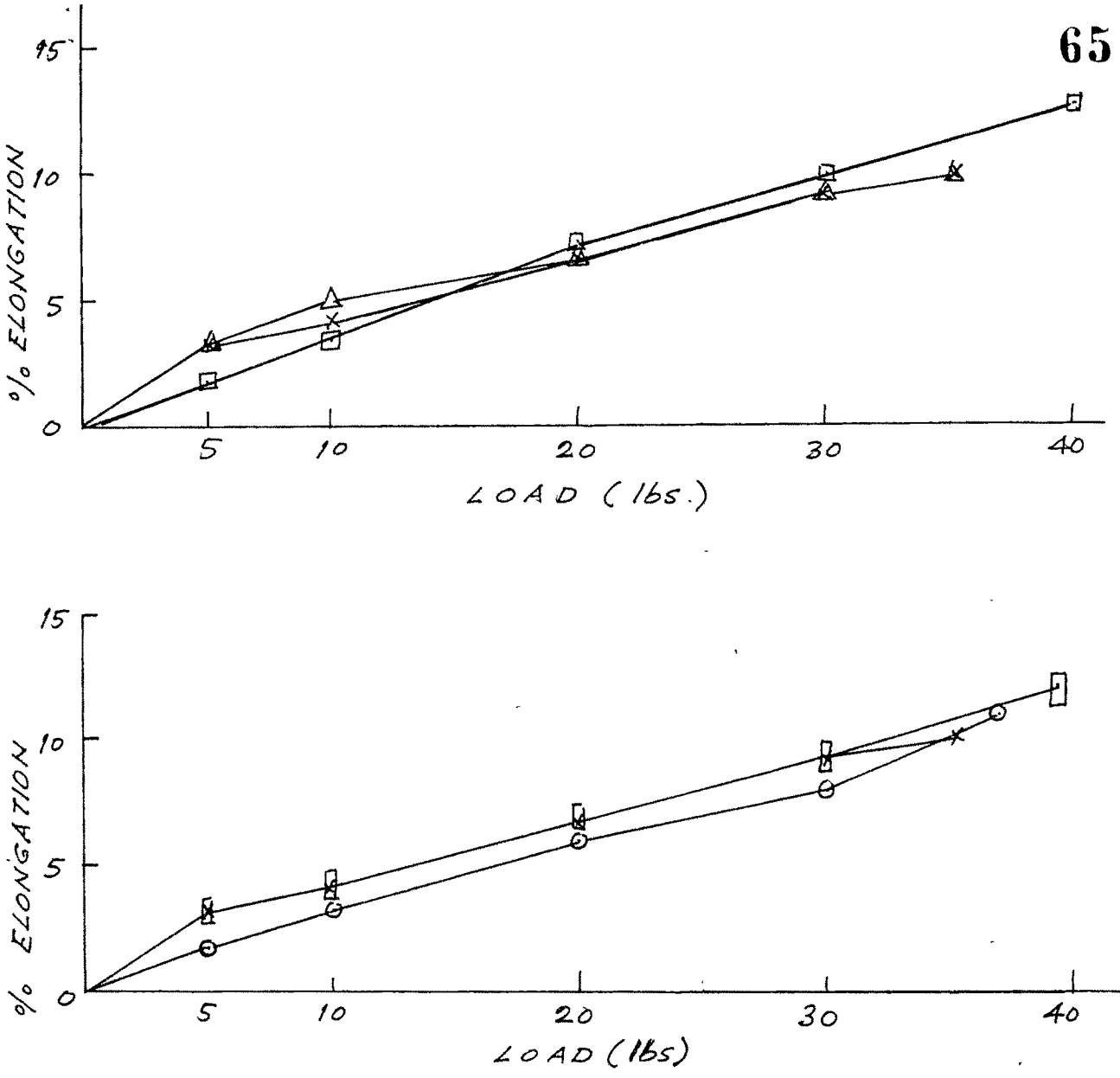
PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS

(POLYESTER FABRIC C) WARP

% Conc. of Finish			Loads (lbs)	Percentage Elongation						
Acrylic		DMDHEU		5	10	20	30	40	EBP	BP (lbs)
0.5		-		3.3	5.0	10.0	16.7	21.0	21.0	(40.2)
1.25		-		3.3	5.0	10.0	16.7	22.7	24.0	(42.0)
2.0		-		3.3	5.0	10.7	17.7	23.7	24.3	(43.1)
2.5		-		3.3	5.0	10.7	16.7	22.7	24.3	(43.0)
-		0.5		4.0	6.0	10.7	16.7	23.3	23.3	(40.6)
-		1.25		4.0	6.7	9.7	15.3	-	22.0	(39.4)
-		2.0		3.3	6.7	11.7	16.7	21.7	22.3	(41.4)
-		2.5		4.0	6.7	11.7	17.0	23.0	23.0	(40.0)
0.5	+	2.0		3.7	7.0	11.7	17.3	22.0	22.0	(40.2)
1.25	+	1.25		5.0	6.3	11.3	15.7	21.0	21.0	(40.0)
2.0	+	0.5		4.3	7.3	12.7	16.7	21.0	22.7	(42.0)
Control				5.0	7.3	12.7	18.3	23.3	25.0	(42.0)

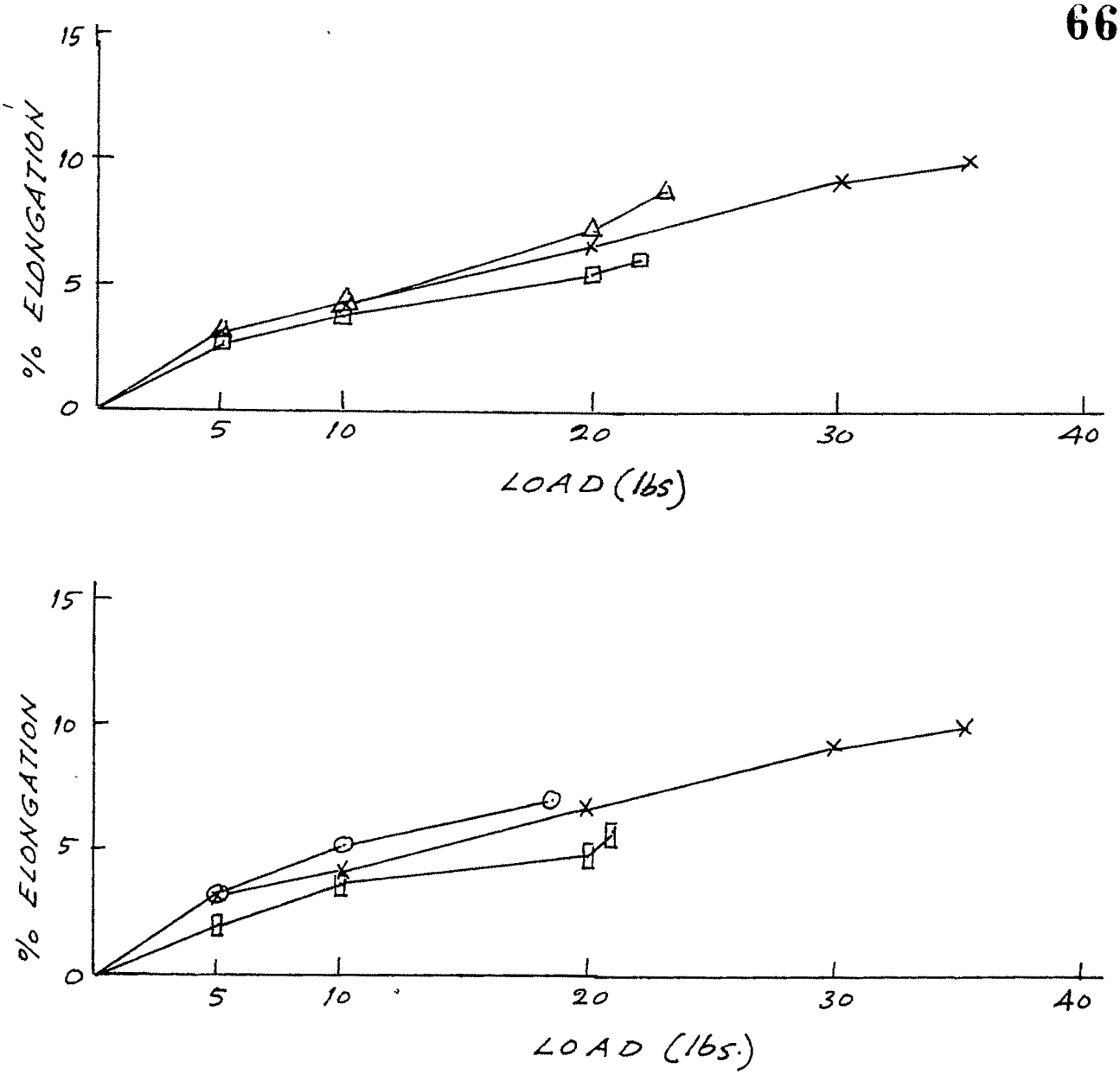
EBP : Elongation at breaking point.

BP : Breaking point.



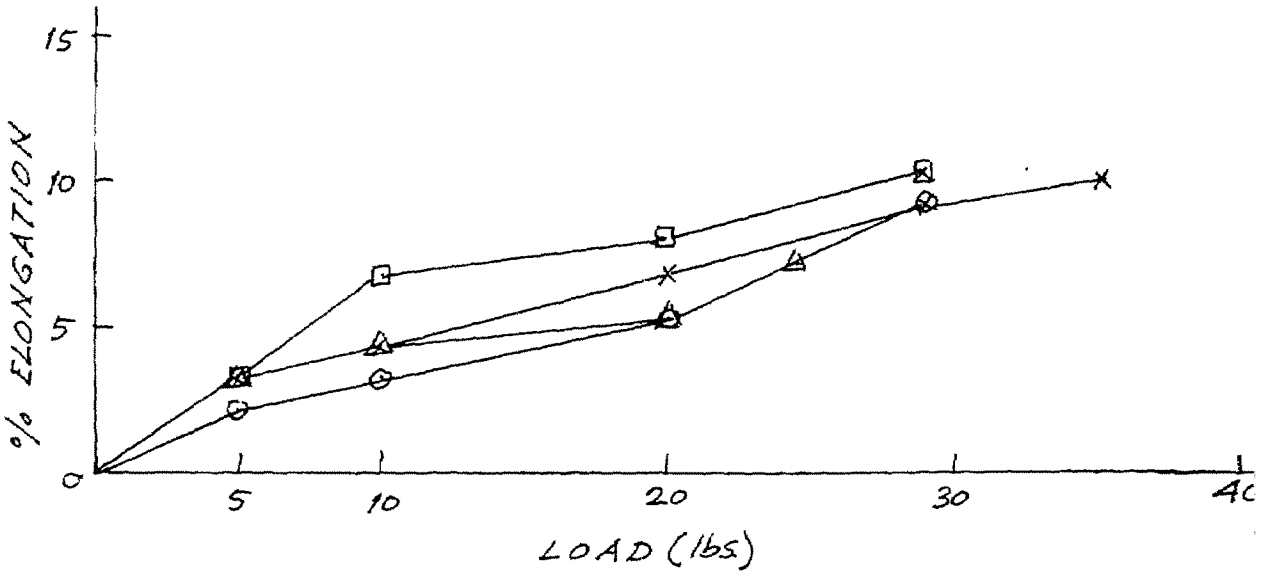
X - CONTROL, △ - 0·5% CONC., ⊡ - 1·25% CONC., ⊡ - 2·0% CONC.
⊙ - 2·5% CONC.

FIG. 10 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (ACRYLIC FINISH, COTTON FABRIC A)



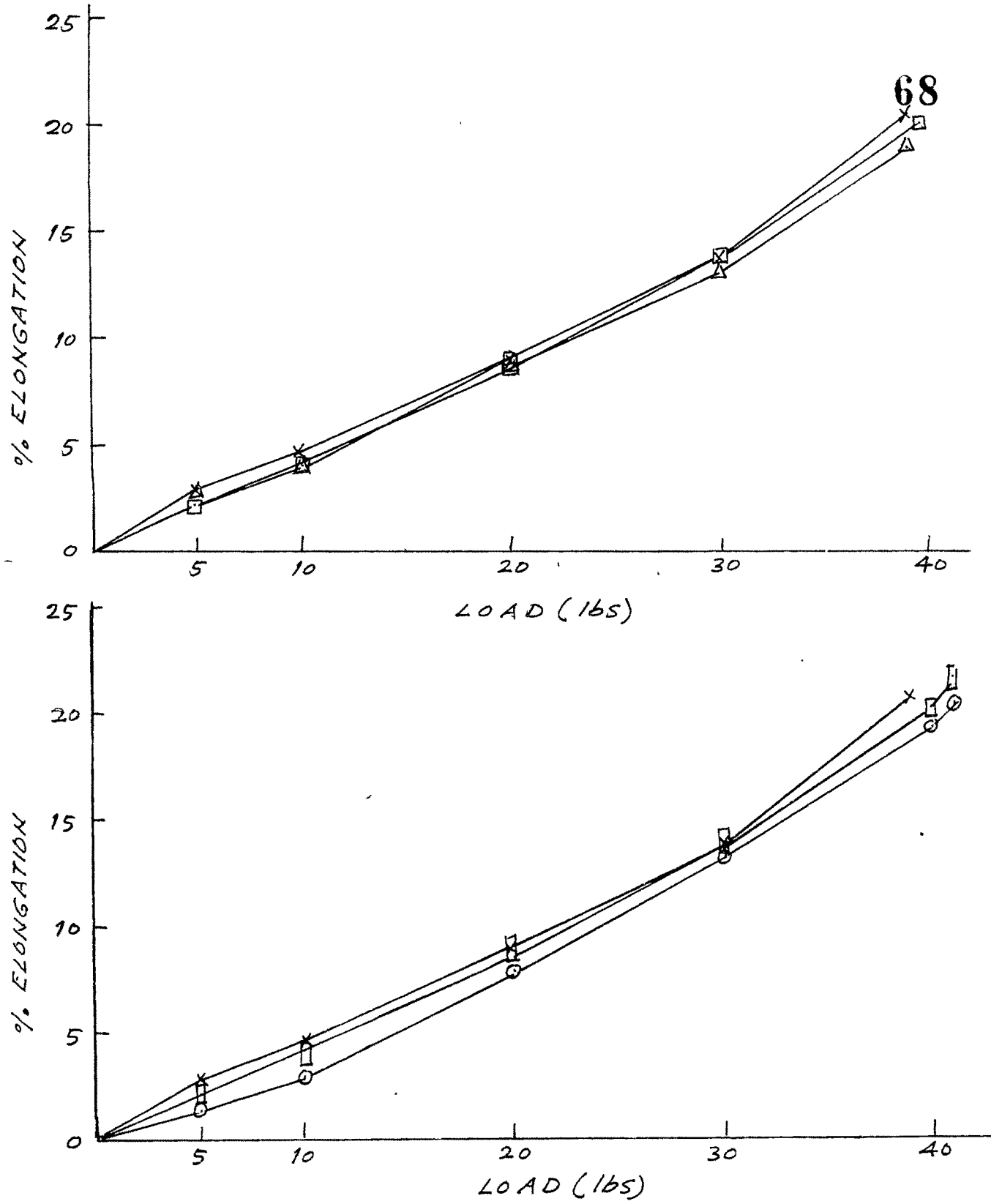
X - CONTROL, Δ - 0·5% CONC., ⊡ - 1·25% CONC., ▯ - 2·0% CONC., ⊙ - 2·5% CONC.

FIG. 11 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (DMDHEU FINISH, COTTON FABRIC A)



X - CONTROL, △ - 0·5% ACRYLIC FINISH + 2·0% DMDHEU FINISH.
⊡ - 1·25% ACRYLIC FINISH + 1·25% DMDHEU FINISH.
⊙ - 2·0% ACRYLIC FINISH + 0·5% DMDHEU FINISH.

FIG. 12 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (COMBINATION FINISH, COTTON FABRIC A)



X - CONTROL, △ - 0·5% CONC., □ - 1·25% CONC., ▯ - 2·0% CONC., ⊙ - 2·5% CONC.

FIG. 13 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (ACRYLIC FINISH, POLYESTER/COTTON FABRIC B)

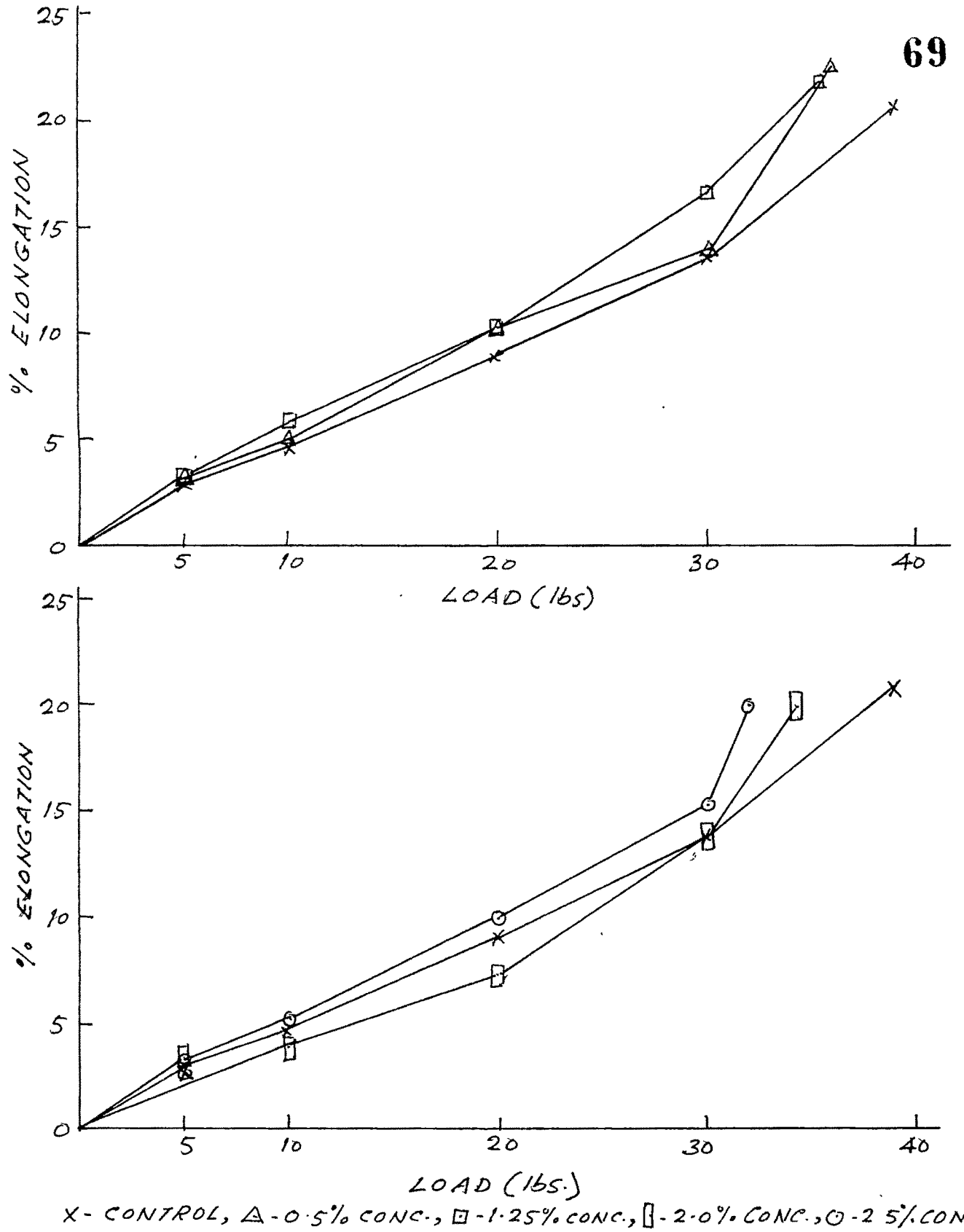
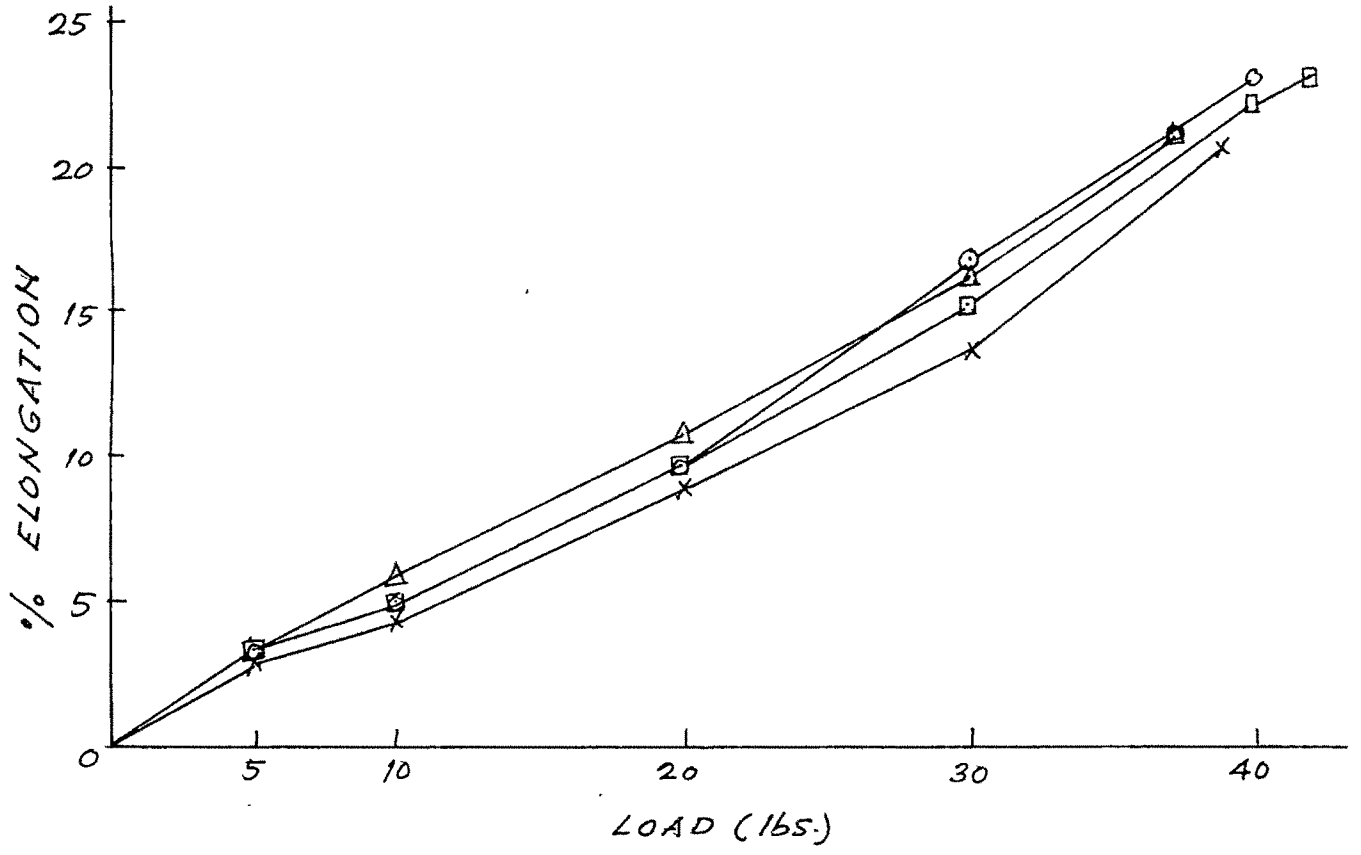


FIG. 14 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (DMDHEU FINISH, POLYESTER/COTTON FABRIC B



X- CONTROL, △-0·5% ACRYLIC FINISH + 2·0% DMDHEU FINISH.
□-1·25% ACRYLIC FINISH + 1·25% DMDHEU FINISH
⊙-2·0% ACRYLIC FINISH + 0·5% DMDHEU FINISH

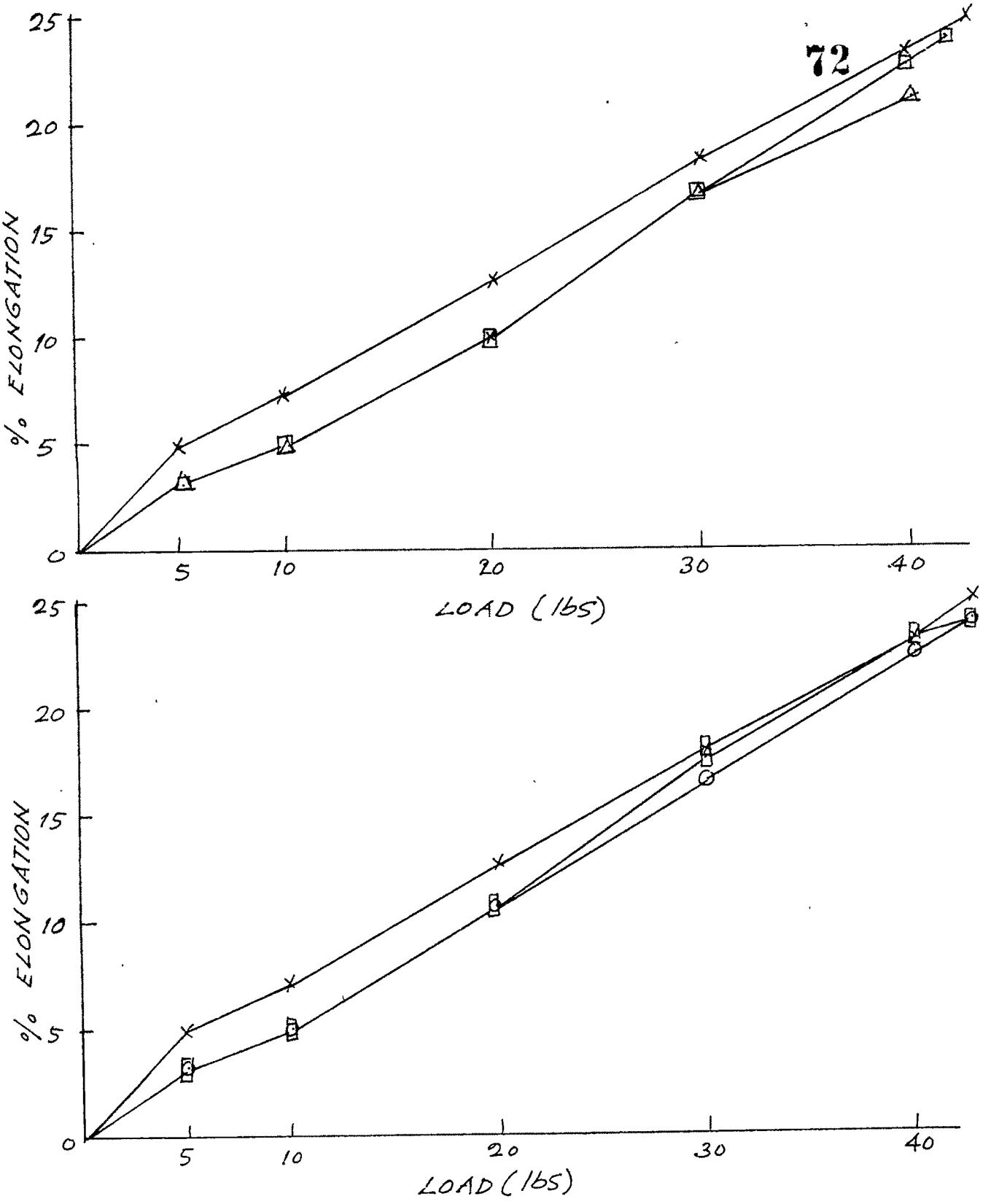
FIG. 15 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (COMBINATION FINISH, POLYESTER/COTTON FABRIC B)

ence of polyester in the fabric. The results indicated that acrylic finish served to improve the elongation of fabric A but did not improve elongation of fabrics B and C.

(b) Effect of DMDHEU finish on the percentage elongation at different loads: Fabric A, when treated with DMDHEU finish behaved very differently as compared to the acrylic finish. The graphs (Figure 11) with all the concentrations ended at much lesser load so also at lower elongation at breaking point. This lowering of elongation could be due to the rigidity produced by cross-links with increase in concentration of the DMDHEU finish. Fabric B, behaved quite differently with DMDHEU finish. The graphs for fabric B (Figure 14) moved steadily upward but not towards the end as rigidity causes loss in strength but not in elongation. This finish had minimum influence on polyester fabric.

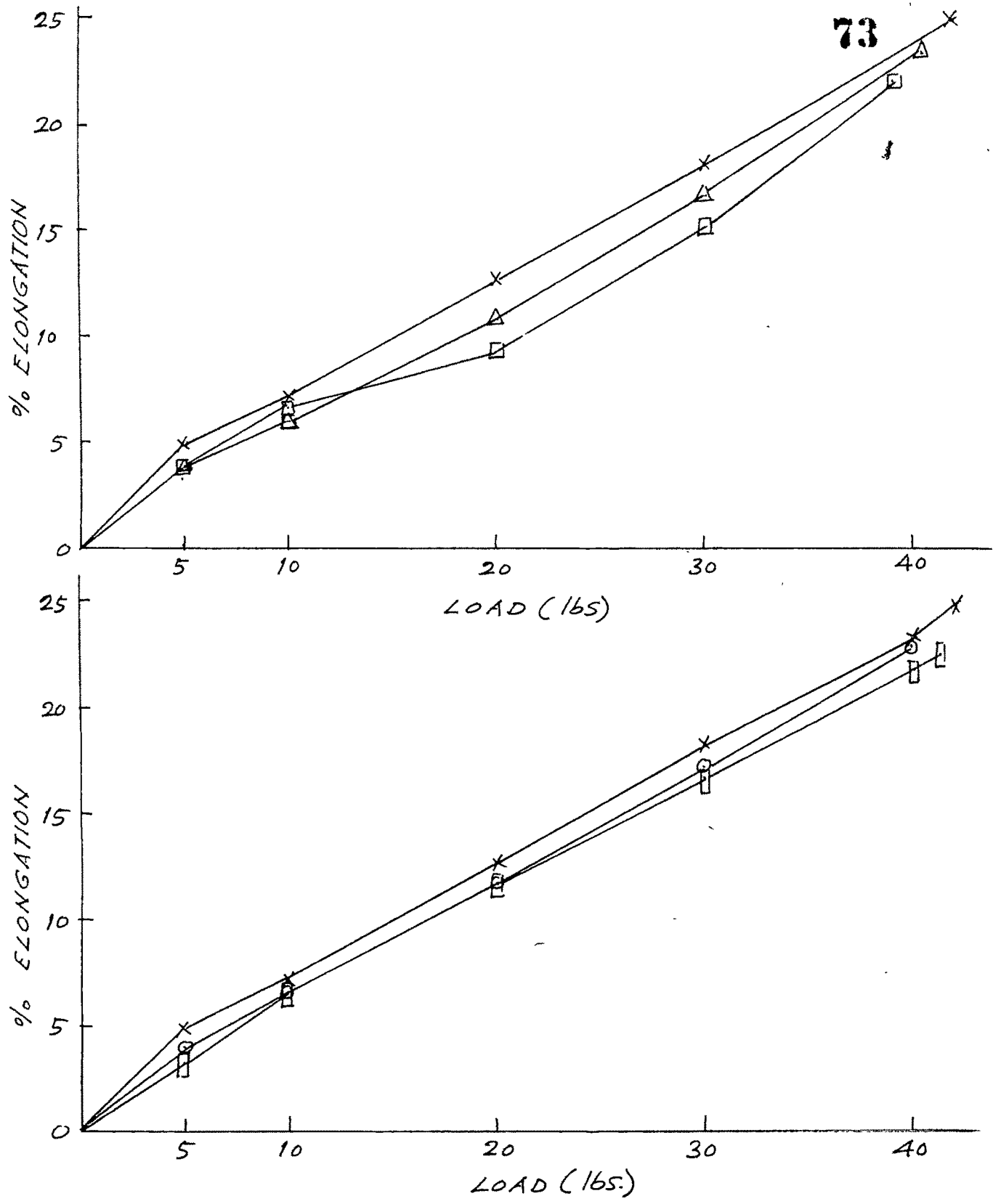
(c) Effect of combination finish on the percentage elongation at different loads: Combination finishes when applied on fabric A (Figure 12) helped to increase the elongation at breaking point as compared to the DMDHEU finish alone, thereby correcting the rigidity introduced by the DMDHEU finish. In the case of polyester/cotton fabric B (Figure 15) combination finishes increased elongation at breaking point as compared to the two finishes alone especially the DMDHEU finish.

On the whole the analysis of the data revealed that



X - CONTROL, △ - 0·5% CONC., ⊡ - 1·25% CONC., ▯ - 2·0% CONC., ⊙ - 2·5% CONC.

FIG. 16 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (ACRYLIC FINISH, POLYESTER FABRIC C)



× - CONTROL, △ - 0·5 % CONC., □ - 1·25% CONC., ▯ - 2·0% CONC., ⊙ - 2·5% CONC.

FIG. 17 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (DMDHEU FINISH, POLYESTER FABRIC C)

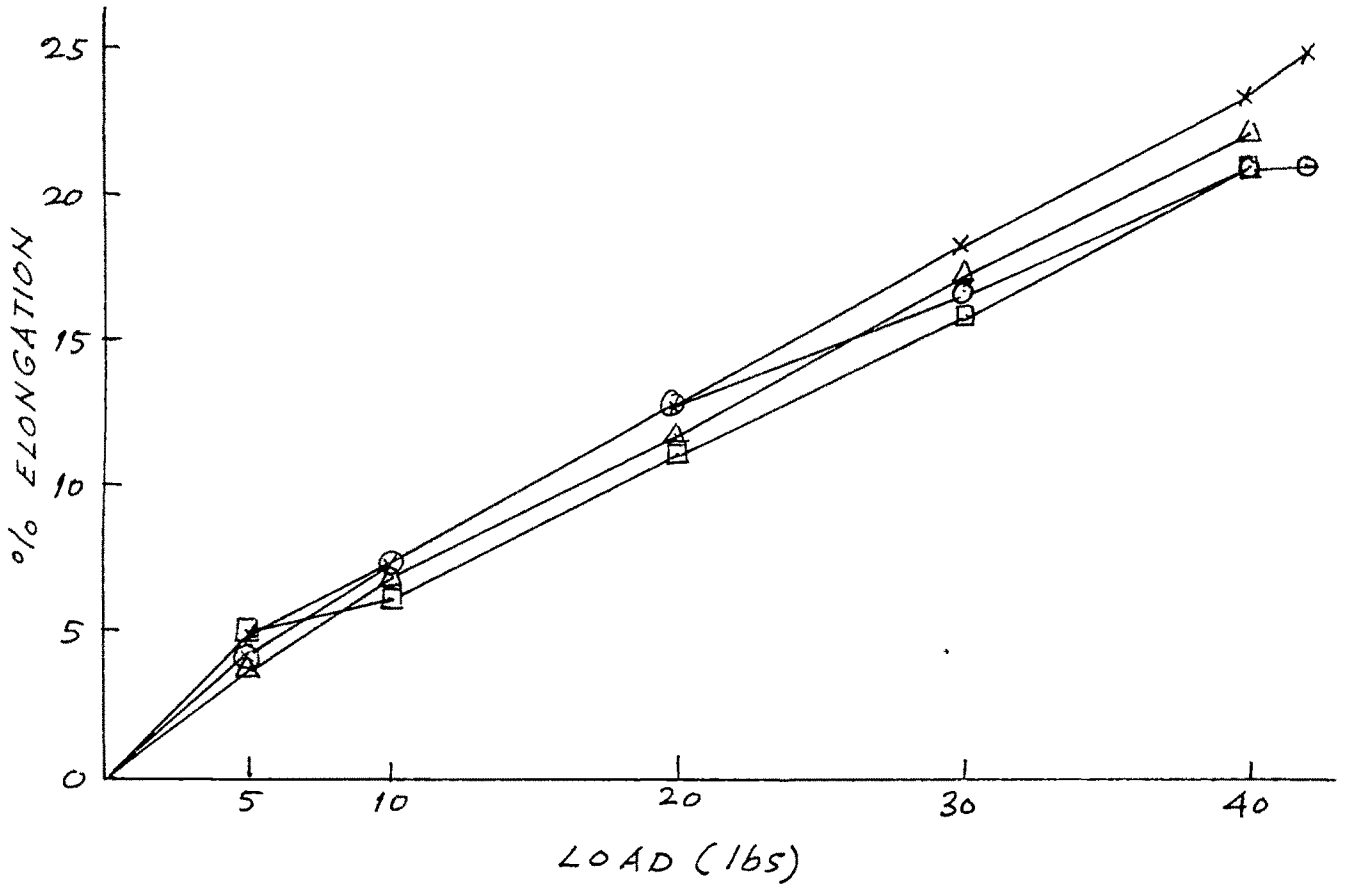


FIG. 18 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (COMBINATION FINISH, POLYESTER FABRIC C)

the effect of different concentrations of the finishes was more in fabric A than in the polyester/cotton fabric B and polyester fabric C. In the fabrics B and C, the more upward trend of the curves (Figures 15 and 18) with higher loads was noticed as compared to the curves of fabric A. This can be explained as the influence of polyester in the blends.

The results indicated that the acrylic finish gave higher elongation than the DMDHEU finish and combination finish helped to overcome the drawbacks of DMDHEU finish of causing rigidity.

4. Effect of Varying Concentrations of Acrylic and DMDHEU Finishes on Appearance Rating.

In an earlier work by Divya (9) it was noted that thermoplastic nature of the acrylic finish gave an ease of ironing and better retention of appearance to the fabric. This has been investigated further in this work, since wrinkle resistance of thermosetting resin was expected to be supplemented by a thermoplastic finish like acrylic finish, when the two are in combination. It was also of special interest of this study to see whether the thermoplastic finish, as a major component, along with thermosetting finish as minor component, imparts the above mentioned properties to a fabric. One could expect cotton fabric finished this way to be closer to its blend and finished blended fabric to be closer to a true synthetic fabric.

The blended fabrics, having synthetic fiber as one component are pressed with warm-to-hot iron (nylon setting). This ability has been considered as ease of ironing (9). Cotton fabrics need to be ironed at relatively higher temperature. (cotton setting). An overcome of this drawback by finishing could then be considered as an improved property like ease of ironing.

The appearance of each finished fabric after wrinkling was evaluated according to AATCC 128-1969. The wrinkles on the samples were observed under an overhead flurocent lighting system with photographs of three dimensional replicas as standards.

The data on these ratings have been presented in Tables 7, 8 and 9 and also illustrated in Figures 19 to 24. The data on appearance rating after ironing with cold iron indicated no improvement. Thus it was noted that there was no influence of the weight of the iron alone in the ease of ironing.

Cotton fabric A treated with acrylic, DMDHEU and combination finishes (Figures 19 and 20) showed improvement in the appearance rating after ironing at nylon setting. As can be seen from the graphs, cotton fabric treated with 2.0 and 2.5 percent of DMDHEU and with the combination finish where DMDHEU is in greater or same proportion to acrylic finish have the maximum score. Acrylic finish alone in general has little

TABLE 7

APPEARANCE RATING OF FINISHED FABRIC SAMPLES

(COTTON FABRIC A)

% Conc. of Finish		Ratings			
Acrylic	DMDHEU	a	b	c	d
0.5	-	1.0	2.0	2.0	3.0
1.25	-	1.0	2.0	2.0	3.0
2.0	-	1.0	2.0	2.0	3.0
2.5	-	1.0	2.0	2.0	3.0
-	0.5	1.0	2.0	2.0	3.5
-	1.25	1.5	2.0	2.0	3.5
-	2.0	2.0	3.0	3.0	4.0
-	2.5	2.0	3.0	3.0	4.0
0.5 +	2.0	1.5	2.5	2.5	4.0
1.25 +	1.25	2.0	2.0	2.5	4.0
2.0 +	0.5	2.0	2.5	2.5	3.0
Control		1.0	1.0	1.0	2.0

a : After wrinkling.

b : Twenty four hours after wrinkling.

c : After ironing with cold iron.

d : After ironing at nylon setting.

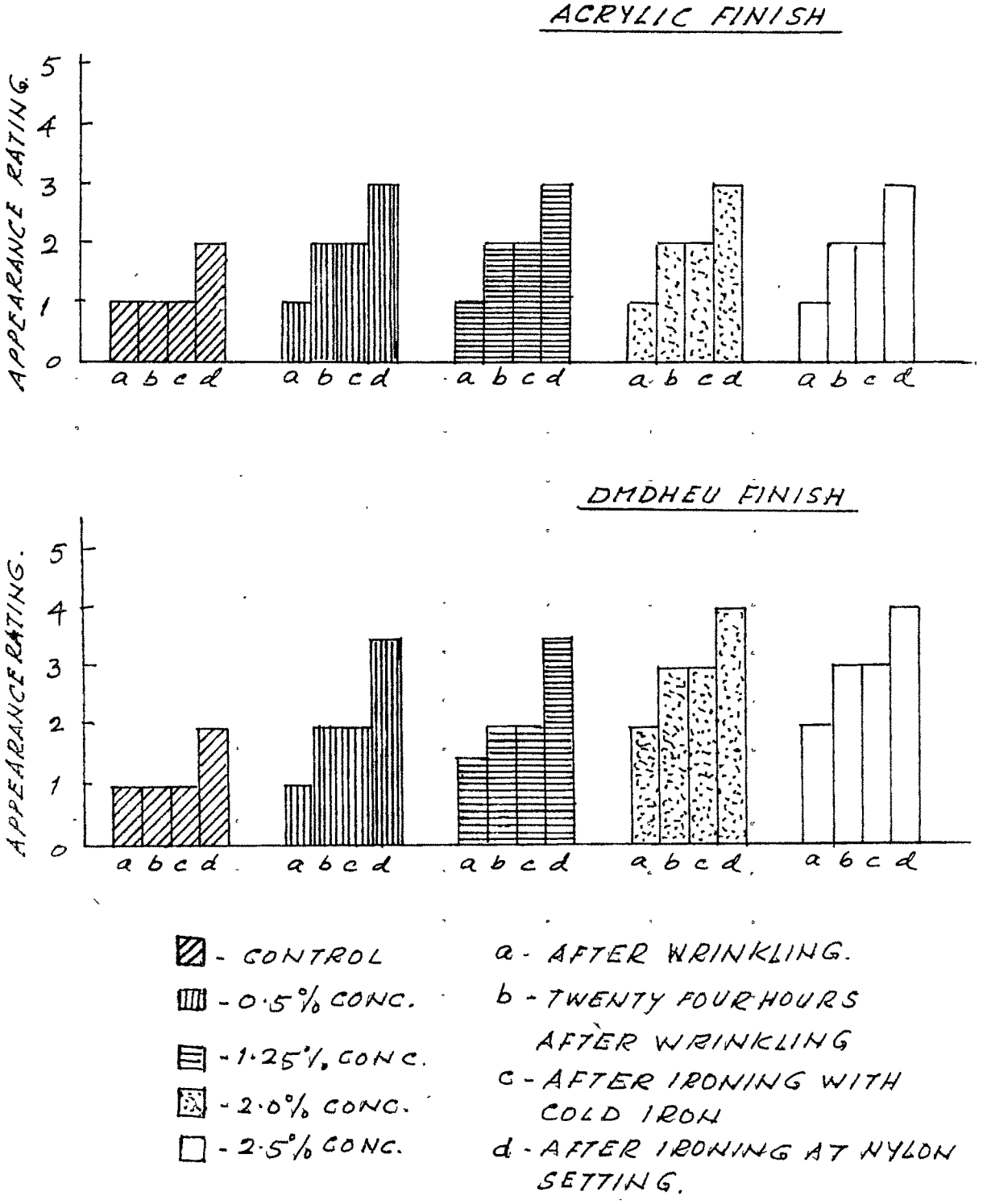
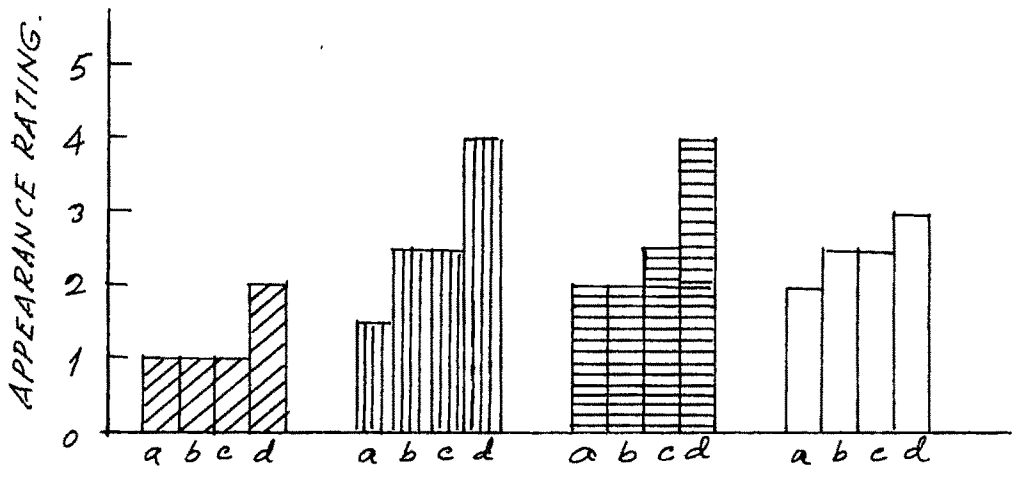


FIG. 19 EFFECT OF ACRYLIC AND DMDHEU FINISHES ON APPEARANCE RATING. (COTTON FABRIC A)



▨ CONTROL
▥ 0·5% Act 2·0% DM
▤ 1·25% Act 1·25% DM
□ 2·0% Act 0·5% DM
AC - ACRYLIC FINISH
DM - DMDHEU FINISH

a - AFTER WRINKLING
b - TWENTY FOUR HOURS AFTER WRINKLING
c - AFTER IRONING WITH COLD IRON.
d - AFTER IRONING AT NYLON SETTING

FIG. 20 EFFECT OF COMBINATION FINISHES ON APPEARANCE RATING (COTTON FABRIC A)

influence as compared to the DMDHEU finish (Figure 19) in improving the ease of ironing property.

The data on appearance rating in general indicated an improvement for polyester/cotton blend fabric B. Polyester/cotton fabric B had higher rating for recovery from wrinkles, twenty four hours after wrinkling, as compared to the ratings for cotton fabric A. All the finishes applied to fabric B (Figures 21 and 22) helped in improving the ease of ironing property although no improvement was seen when finished with 0.5 percent of acrylic and DMDHEU finish. At this concentration of the two finishes the values obtained were same as original. This indicated that higher concentrations of finish helped to improve the ease of ironing property. Fabric B finished with acrylic finish of 1.25 percent concentration, DMDHEU finish of 2.5 percent concentration and combination finish with similar or higher proportion of DMDHEU to acrylic finish gave the highest rating of five. The ease of ironing can be said as enhanced by the finishes. Greater improvement in ease of ironing with fabric B as compared to cotton fabric A can be attributed to the polyester content in fabric B.

Polyester fabric C by itself has high rating value. The data indicated (Figure 23) that acrylic finish with 2.0 percent and more concentrations lowered the rating values. When treated with 2.0 and 2.5 percent concentrations of DMDHEU finish the ratings for twenty four hours

TABLE 8

APPEARANCE RATING OF FINISHED FABRIC SAMPLES

(POLYESTER COTTON FABRIC B)

% Conc. of Finish		Ratings			
Acrylic	DMDHEU	a	b	c	d
0.5	-	1.5	3.0	3.0	4.0
1.25	-	1.5	3.0	3.0	5.0
2.0	-	1.5	3.0	3.0	4.5
2.5	-	2.0	3.0	3.0	4.5
-	0.5	2.0	3.0	3.0	4.0
-	1.25	2.0	3.0	3.0	4.5
-	2.0	2.0	3.0	3.0	4.5
-	2.5	2.0	3.0	3.0	5.0
0.5 +	2.0	2.0	3.0	3.0	5.0
1.25 +	1.25	2.0	3.0	3.0	5.0
2.0 +	0.5	2.0	2.5	3.0	4.5
Control		2.0	2.0	2.0	4.0

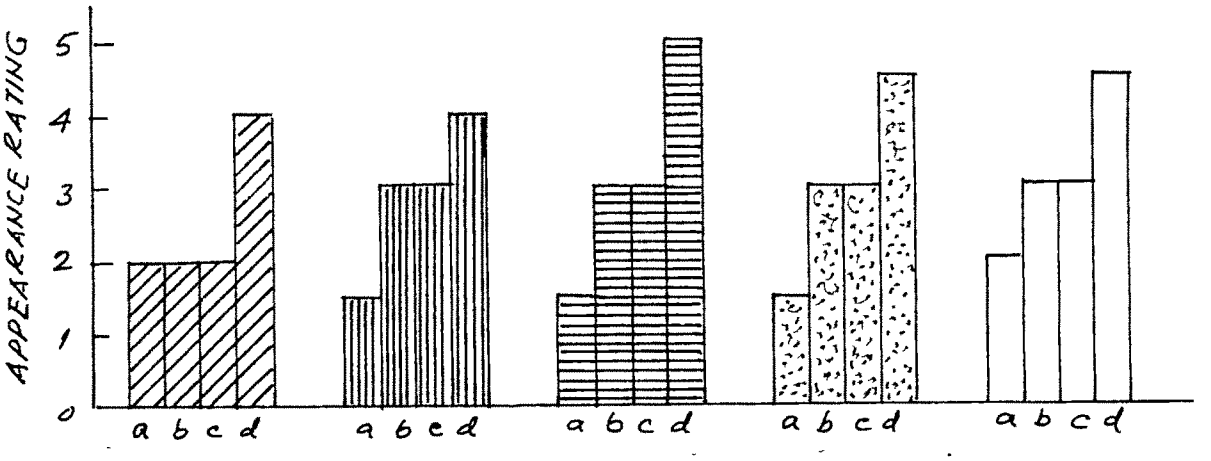
a : After wrinkling.

b : Twenty four hours after wrinkling.

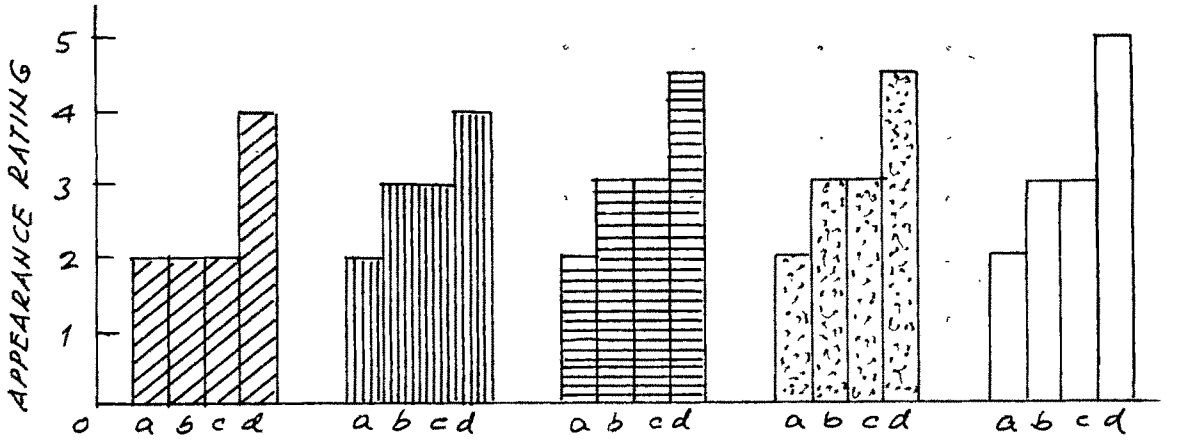
c : After ironing with cold iron.

d : After ironing at nylon setting.

ACRYLIC FINISH



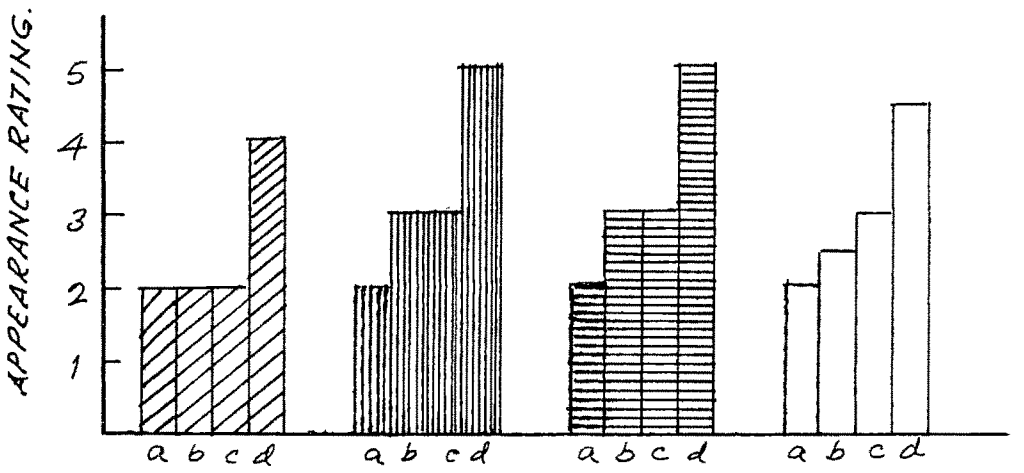
DMDHEU FINISH



CONTROL
0·5 % CONC.
1·25 % CONC.
2·0 % CONC.
2·5 % CONC.

a - AFTER WRINKLING
b - TWENTY FOUR HOURS AFTER WRINKLING.
c - AFTER IRONING WITH COLD IRON
d - AFTER IRONING AT NYLON SETTING.

FIG. 21 EFFECT OF ACRYLIC AND DMDHEU FINISHES ON APPEARANCE RATING. (POLYESTER/COTTON FABRIC B)



CONTROL

0·5% Ac + 2·0% DM.

1·25% Ac + 1·25% DM.

2·0% Ac + 0·5% DM.

Ac - ACRYLIC FINISH

DM - DMDHEU FINISH.

a - AFTER WRINKLING

b - TWENTY FOUR HOURS AFTER WRINKLING

c - AFTER IRONING WITH COLD IRON

d - AFTER IRONING AT NYLON SETTING.

FIG. 22 EFFECT OF COMBINATION FINISHES ON APPEARANCE RATING (POLYESTER/COTTON FABRIC B)

TABLE 9

APPEARANCE RATING OF FINISHED FABRIC SAMPLES

(POLYESTER FABRIC C)

% Conc. of Finish		Ratings			
Acrylic	DMDHEU	a	b	c	d
0.5	-	2.0	3.5	3.5	5.0
1.25	-	2.0	4.0	4.0	5.0
2.0	-	2.0	4.0	4.0	4.5
2.5	-	2.0	3.0	3.0	4.0
-	0.5	2.0	4.0	4.0	5.0
-	1.25	2.0	4.0	4.0	5.0
-	2.0	2.0	3.5	3.5	5.0
-	2.5	2.0	3.0	3.5	5.0
0.5 +	2.0	2.0	4.0	4.0	5.0
1.25 +	1.25	2.0	3.0	3.0	5.0
2.0 +	0.5	2.0	2.5	2.5	4.0
Control		2.5	4.0	4.0	5.0

a : After wrinkling.

b : Twenty four hours after wrinkling.

c : After ironing with cold iron.

d : After ironing at nylon setting.

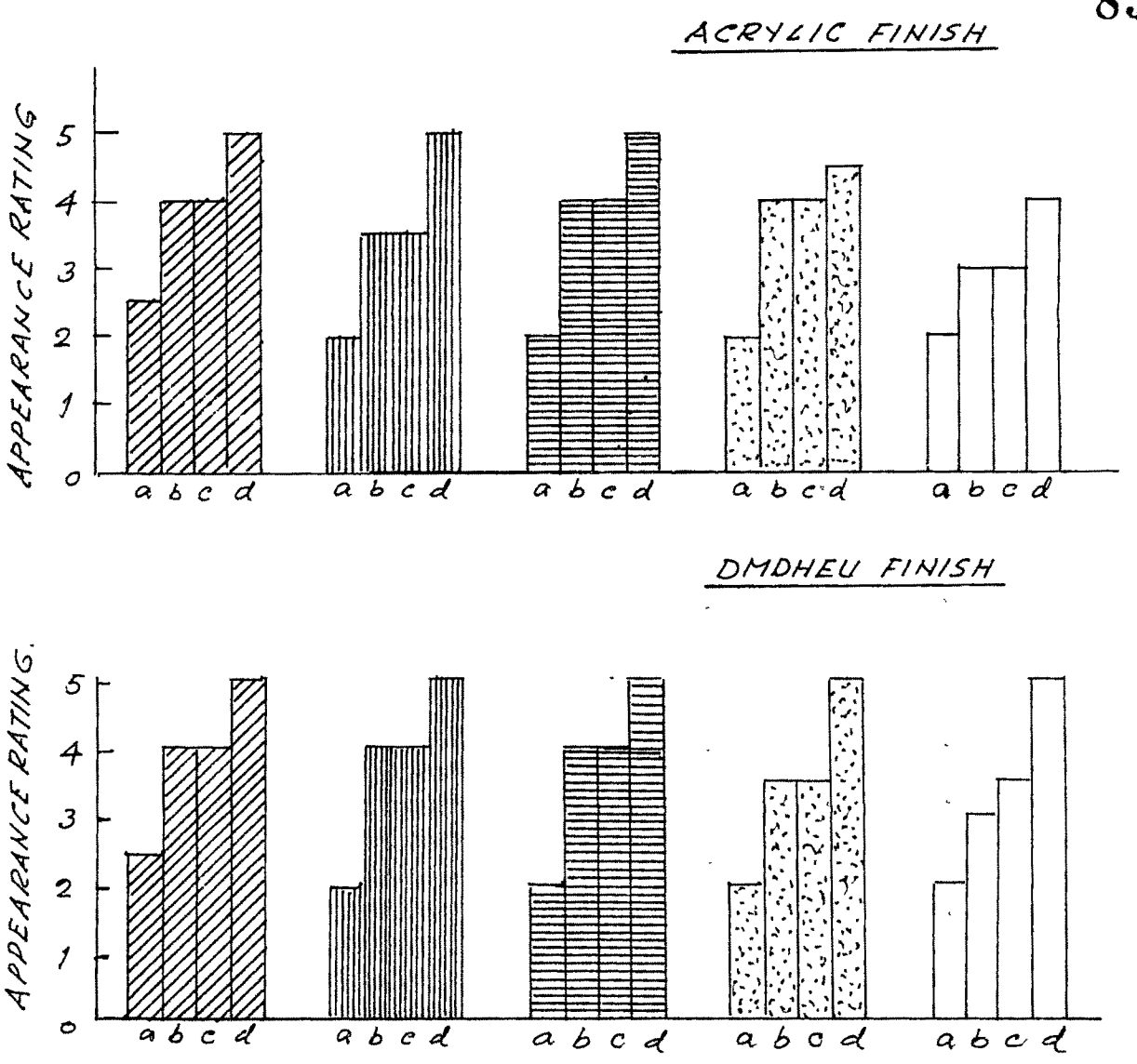
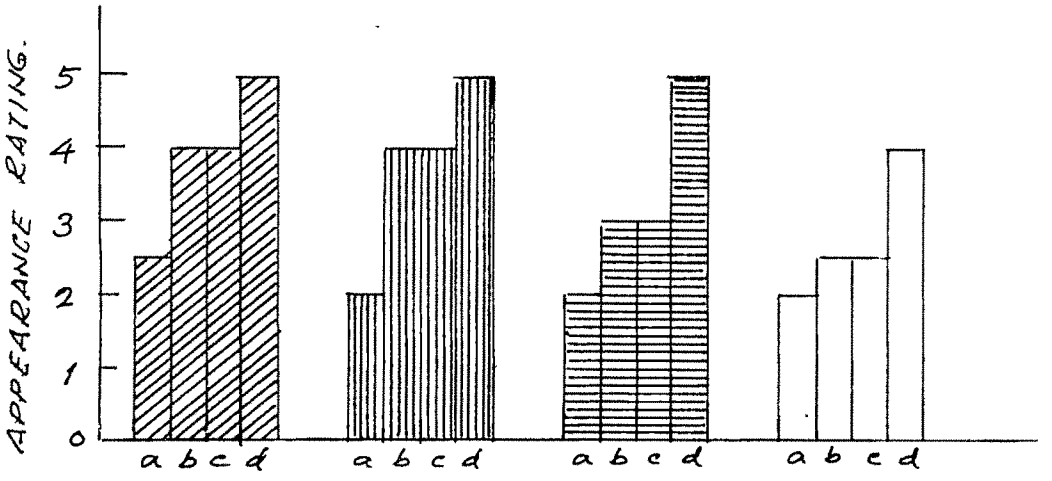


FIG. 23 EFFECT OF ACRYLIC AND DMDHEU FINISHES ON APPEARANCE RATING. (POLYESTER FABRIC C)



- CONTROL
- 0·5% Ac+ 2·0% DM
- 1·25% Ac+ 1·25% DM
- 2·0% Ac+ 0·5% DM

Ac- ACRYLIC FINISH
DM-DMDHEU FINISH

a - AFTER WRINKLING
b - TWENTY FOUR HOURS AFTER WRINKLING
c - AFTER IRONING WITH COLD IRON
d - AFTER IRONING AT NYLON SETTING.

FIG. 24 EFFECT OF COMBINATION FINISHES ON APPEARANCE RATING (POLYESTER FABRIC C)

after wrinkling and ironing with cold iron were lowered as compared to the control fabric. This indicates that polyester, if to be treated, should be treated at lower level of concentrations of the finish.

PART II

In the preceding part of this chapter (Part I), results on the effect of varying concentrations of acrylic and DMDHEU finishes and their combinations are discussed. It transpired from these results that acrylic finish in greater or similar proportion to DMDHEU finish helped to improve upon strength characteristic, while DMDHEU finish in greater or equal ratio to acrylic finish improved upon the wrinkle recovery and ease of ironing especially with cotton (Fabric A) and polyester/cotton (Fabric B).

It was necessary to see, whether the combination finish with same ratios but with double the concentration of the finish had also similar beneficial effect. It was also of interest to study whether the optimum concentration of the combination finish varies with the type of blend that is as per the polyester/cotton content in the blend. For this reason 50:50 polyester/cotton fabric (Fabric D) was also used in the second part of the study. The physical properties of polyester fabric C were not influenced by any of the finishes studied and hence that fabric was deleated in this part of the study. The data on combination finishes given

in Tables 2 to 5, 7 and 8 of Part I has also been reported in Part II for comparison.

5. Effect of Varying Concentrations of Combination Finishes on Wrinkle Recovery.

The data on wrinkle recovery of fabrics A, B and D finished with varying concentrations of combination finishes has been given in Table 10 and has been represented graphically in Figure 25.

The effect of combination finishes on cotton fabric A as seen from the data revealed that there was no appreciable difference in wrinkle recovery when the percentage concentration was double. It is evident from the data in general that with cotton fabric, improvement in wrinkle recovery is better with combination finishes having greater or similar amount of DMDHEU finish to acrylic finish.

In the case of 67/33 polyester/cotton fabric B, it was indicated that higher percentage of combination finishes were not more beneficial than lower percentage, the values being almost equivalent. All the combination finishes helped in improving the wrinkle recovery, though with equal proportions of both the finishes the values obtained were higher.

The combination finishes for fabric D, 50/50 polyester/cotton, showed an appreciable increase in wrinkle recovery, and that with higher concentrations of finishes there was

TABLE 10

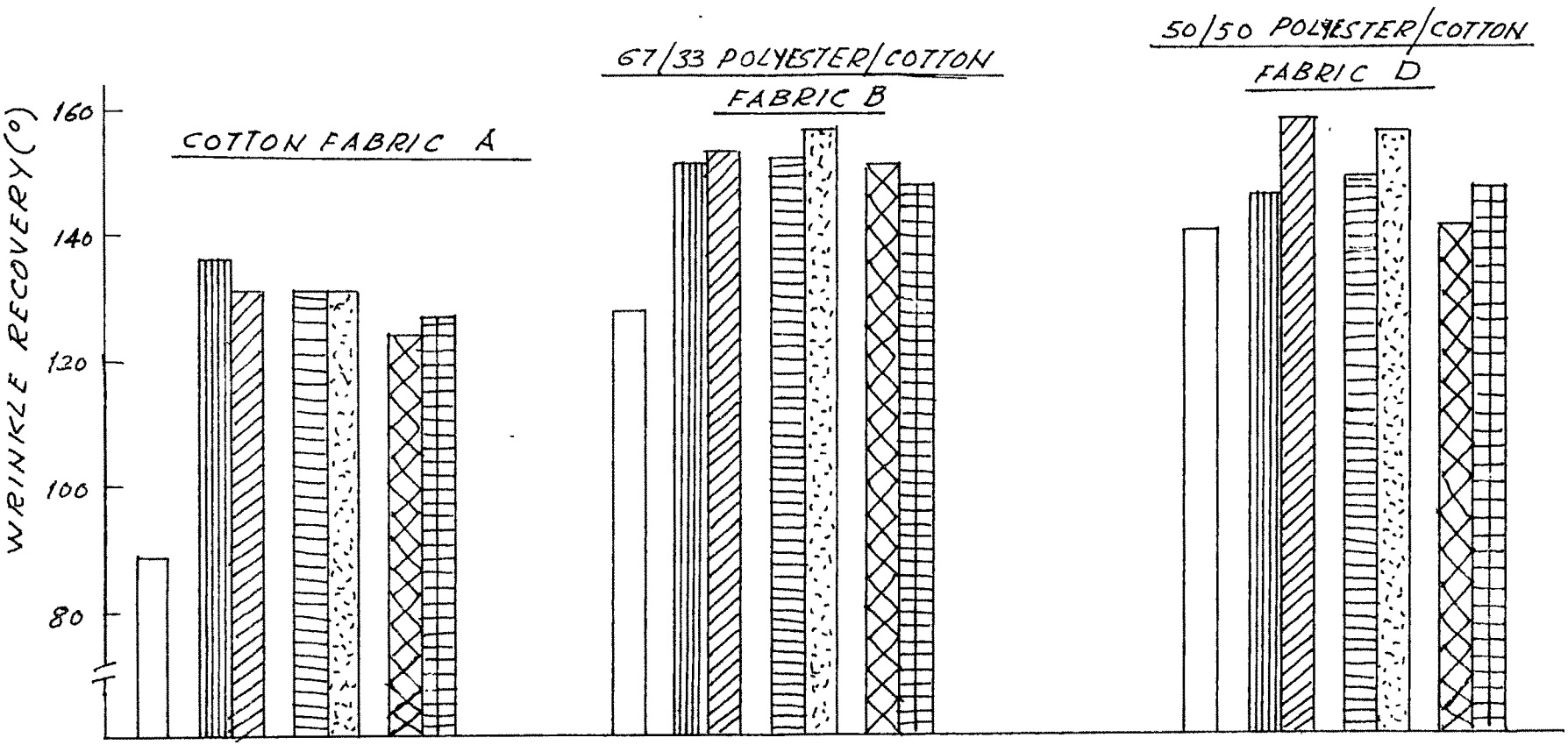
WRINKLE RECOVERY IN DEGREES OF FINISHED FABRICS (WARP) AT DIFFERENT CONCENTRATIONS OF FINISHES USED

% Conc. of Finish			Wrinkle Recovery (°) Warp		
Acrylic		DMDHEU	Fabrics A	B	D
0.5	+	2.0	135.9	151.1	145.9
1.25	+	1.25	131.3	152.1	149.0
2.0	+	0.5	124.0	150.7	141.3
1.0	+	4.0	131.0	152.8	157.9
2.5	+	2.5	131.0	156.4	155.8
4.0	+	1.0	127.0	147.6	146.9
Control			89.3	128.4	139.9

Fabric A : Cotton

Fabric B : 67/33 Polyester/Cotton

Fabric D : 50/50 Polyester/Cotton



AC - ACRYLIC FINISH, DM - DMDHEU FINISH

□ - CONTROL, ▥ - 0·5% AC + 2·0% DM, ▨ - 1·0% AC + 4·0% DM,

▤ - 1·25 AC + 1·25 DM, ⊡ - 2·5% AC + 2·5% DM,

⊠ - 2·0% AC + 0·5% DM, ⊞ - 4·0% AC + 1·0% DM.

FIG. 25 WRINKLE RECOVERY OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS OF COMBINATION FINISHES

an additional improvement in wrinkle recovery. A higher or similar amount of DMDHEU to acrylic finish showed more increase in the wrinkle recovery values than to the lesser proportion of DMDHEU to acrylic finish.

Greater improvement in wrinkle recovery with similar or higher proportion of DMDHEU in a combination finish was ascribed to cross-linkages between cellulose chains and so the improvement was more with more cellulose content.

6. Effect of Varying Concentrations of Combination Finishes on Tensile Strength.

The data on tensile strength of finished fabrics with different combination finishes has been given in Table 11. The effect of each of the combination finishes shown in Figure 26 was to decrease the strength to a varying extent; the variation being examined for any recovery from the loss in strength.

When cotton fabric A was finished with higher concentration, the recovery from the loss in strength was more than that with the finishes at lower concentrations. With cotton fabric A, the strength was noted highest with 2.5 percent acrylic plus 2.5 percent DMDHEU combination finish which is quite close to the strength of the control fabric.

Polyester/cotton fabric B behaved differently as compared to cotton fabric A. With fabric B, better results were noted with lower concentrations and at equal ratios of the two

TABLE 11

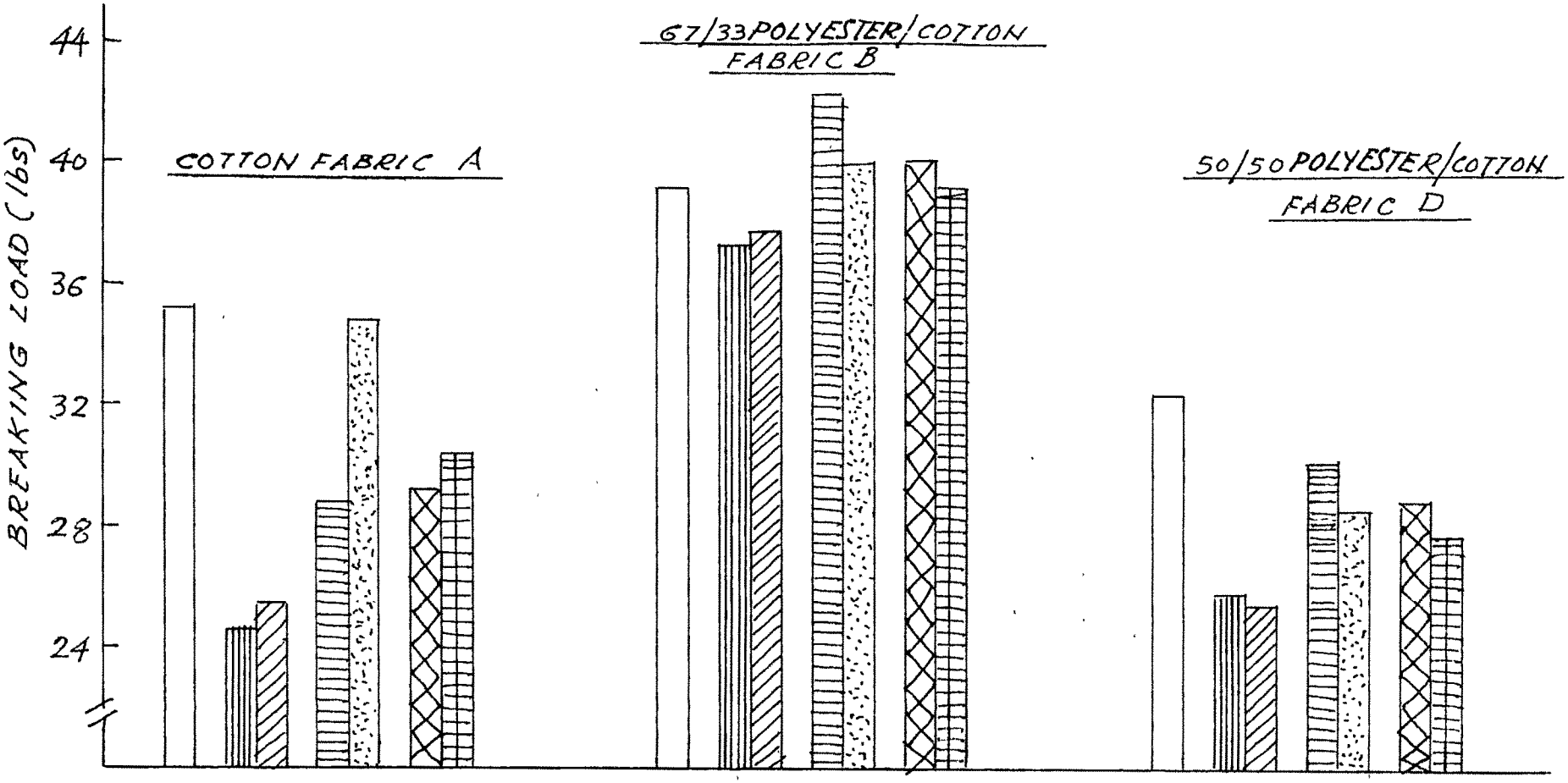
TENSILE STRENGTH IN Lbs. OF FINISHED FABRICS (WARP) AT DIFFERENT CONCENTRATIONS OF FINISHES USED

% Conc of Finish			Fabrics	Tensile Strength in Lbs		
Acrylic		DMDHEU		A	B	D
0.5	+	2.0		24.6	37.2	25.7
1.25	+	1.25		28.8	42.2	30.0
2.0	+	0.5		29.2	40.0	28.7
1.0	+	4.0		25.5	37.6	25.3
2.5	+	2.5		34.8	39.9	28.4
4.0	+	1.0		30.4	39.1	27.6
Control				35.2	39.1	32.3

Fabric A : Cotton

Fabric B : 67/33 Polyester/Cotton

Fabric D : 50/50 Polyester/Cotton



AC - ACRYLIC FINISH, DM - DMDHEU FINISH

□ - CONTROL, ▥ - 0·5% AC + 2·0% DM, ▨ - 1·0% AC + 4·0% DM, ▤ - 1·25% AC + 1·25% DM, ▩ - 2·5% AC + 2·5% DM, ▧ - 2·0% AC + 0·5% DM, ⊞ - 4% AC + 1·0% DM.

FIG. 26 TENSILE STRENGTH OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS OF COMBINATION FINISHES

finishes namely acrylic and DMDHEU finishes.

When 50/50 polyester/cotton fabric D was finished with the combination finishes, no appreciable difference was noted among the various treatments. Amongst these loss in strength was minimum with equal and higher percentage of acrylic finish to DMDHEU finish indicating that the acrylic finish helped to recover some strength loss.

7. Effect of Varying Concentrations of Combination Finishes on the Percentage Elongation at Different Loads.

The data on the percentage elongation at different loads has been given in Tables 12 to 14 and illustrated in Figures 27 to 29. Cotton fabric A when treated with combination finishes (Figure 27) indicated a decrease in elongation as compared to the control fabric with the exception that when treated with 1.25 percent acrylic + 1.25 percent DMDHEU finish, a slight increase in elongation was seen. Among all the treatments of combination finish for fabric A, the finish with 1:4 ratio of acrylic and DMDHEU finish of 5 percent concentration had the lowest elongation value at breaking point, caused by higher ratio of DMDHEU finish.

The graphs for 67/33 polyester/cotton fabric B, treated with combination finishes (Figure 28) are all above to that of the control fabric. Moreover, the elongation at breaking point is also higher or similar. Percentage elongation at breaking point is highest (23.3) for fabric treated with

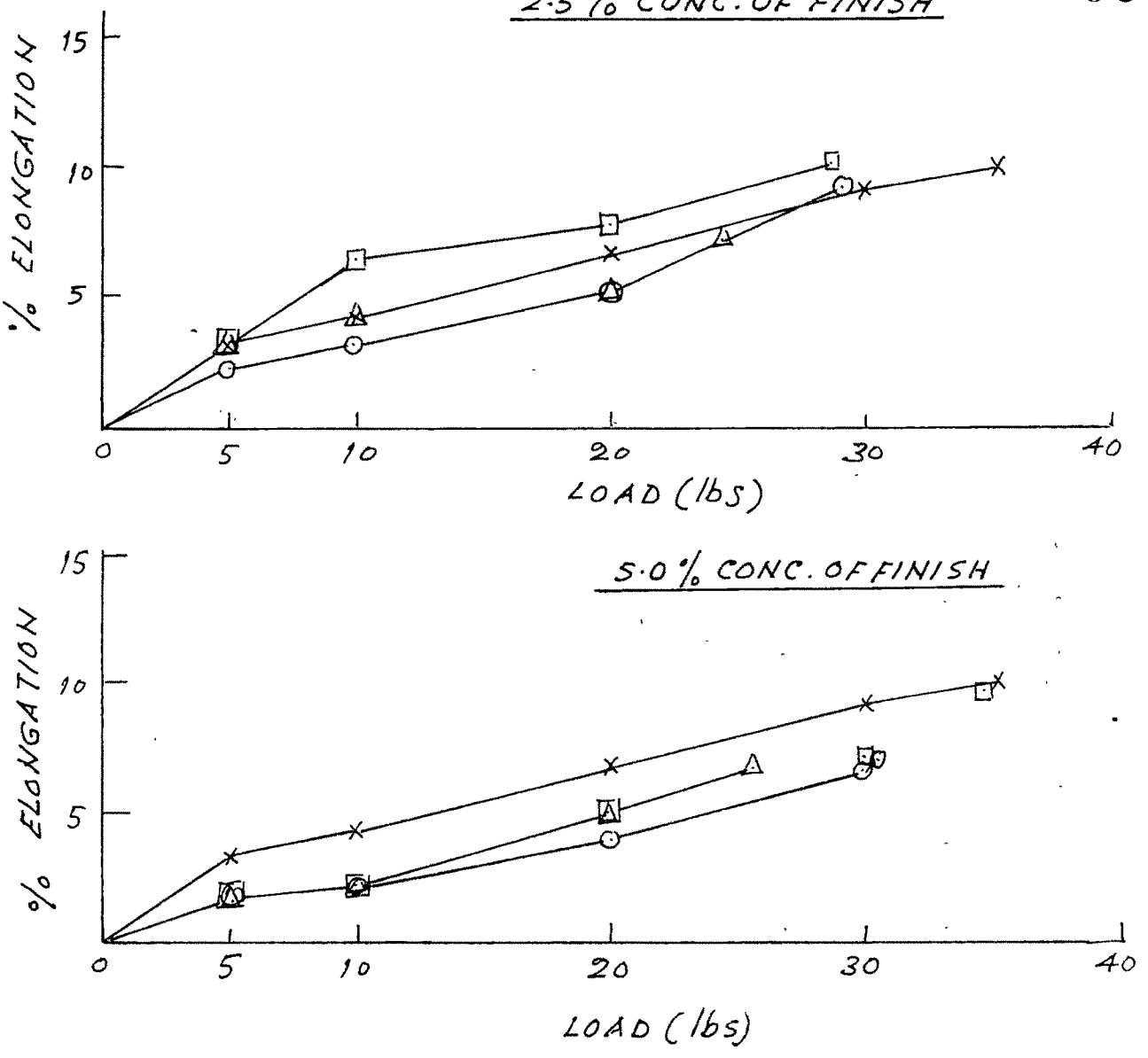
TABLE 12I

PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (COTTON FABRIC A) WARP

% Conc. of Finish			Loads (lbs)	Percentage Elongation					BP (lbs)
Acrylic		DMDHEU		5	10	20	30	EBP	
0.5	+	2.0		3.3	4.3	5.3	-	7.3	(24.6)
1.25	+	1.25		3.3	6.7	8.0	-	10.3	(28.8)
2.0	+	0.5		2.3	3.3	5.3	-	9.3	(29.2)
1.0	+	4.0		1.7	2.3	5.0	-	6.7	(25.5)
2.5	+	2.5		1.7	2.3	5.0	7.3	9.7	(34.8)
4.0	+	1.0		1.7	2.3	4.0	6.7	7.0	(30.4)
Control				3.3	4.3	6.7	9.3	10.0	(35.2)

EBP : Elongation at breaking point.

BP : Breaking point.



× - CONTROL
△ - 1:4 OF ACRYLIC AND DMDHEU FINISH
□ - 1:1 OF ACRYLIC AND DMDHEU FINISH
⊙ - 4:1 OF ACRYLIC AND DMDHEU FINISH.

FIG. 27 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS OF COMBINATION FINISHES (COTTON FABRIC A)

TABLE 13

PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (POLYESTER/COTTON FABRIC B) WARP

% Conc. of Finish			Loads (lbs)	Percentage Elongation						
Acrylic		DMDHEU		5	10	20	30	40	EBP	BP (lbs)
0.5	+	2.0		3.3	6.0	10.7	16.3	-	21.0	(37.2)
1.25	+	1.25		3.3	5.0	9.7	15.3	22.3	23.3	(42.2)
2.0	+	0.5		3.3	5.0	9.7	16.7	23.0	23.0	(40.2)
1.0	+	4.0		3.3	5.0	9.7	16.3	-	21.0	(37.6)
2.5	+	2.5		3.3	5.0	9.3	14.0	-	20.7	(39.9)
4.0	+	1.0		4.0	6.7	10.0	15.3	-	21.7	(39.1)
Control				3.0	4.7	9.0	13.7	-	20.7	(39.1)

EBP : Elongation at breaking point.

BP : Breaking point.

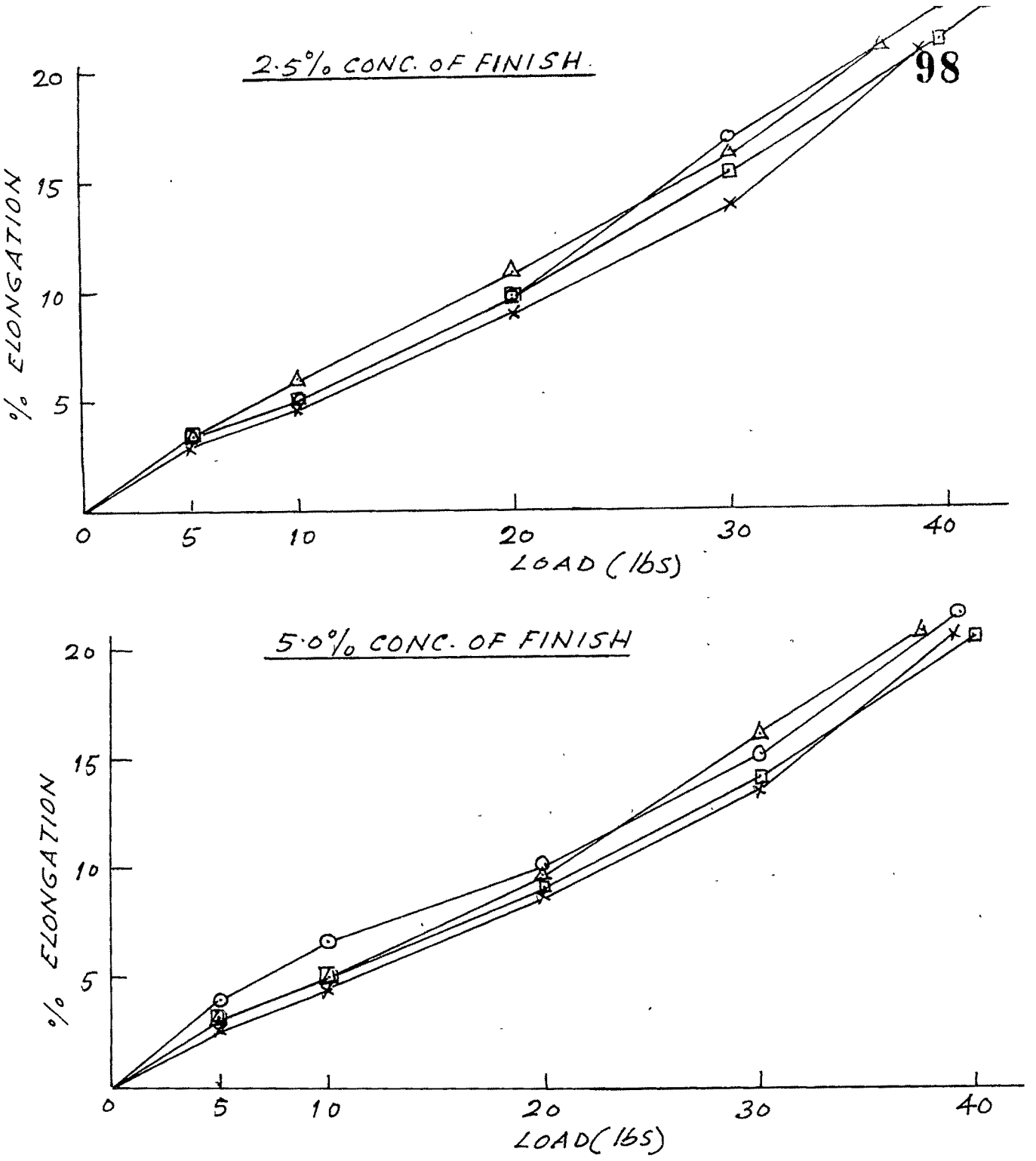


FIG. 28 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISH FABRICS AT DIFFERENT CONCENTRATIONS OF COMBINATION FINISHES (POLYESTER COTTON FABRIC B)

1.25 percent acrylic finish + 1.25 percent of DMDHEU finish. In case of fabric B, the decrease in strength has not been reflected in loss of percentage elongation at breaking point. This was thus attributed to the polyester content in the fabric B.

In case of 50/50 polyester/cotton fabric D (Figure 29), percentage elongation at breaking point was similar to that with control fabric with the higher or equal proportion of acrylic finish to DMDHEU at 2.5 percent concentration, though there was some loss in strength. With 2.5 percent concentration of combination finish the graphs are quite close to control initially but towards the breaking point the graphs are above the graph of original fabric. With 5 percent concentration, the graphs initially are lower to the graph of control and later they moved upward. The beneficial effect of the presence of acrylic finish along with DMDHEU finish in reducing the rigidity caused by latter was thus seen.

8. Effect of Varying Concentrations of Combination Finishes on Appearance Rating.

The appearance ratings of samples have been given in Tables 15 to 17 and illustrated in Figures 30 to 32. The data on appearance rating indicated that cotton fabric A treated with combination finishes of 2.5 and 5.0 percent concentrations, having DMDHEU finish in greater or in

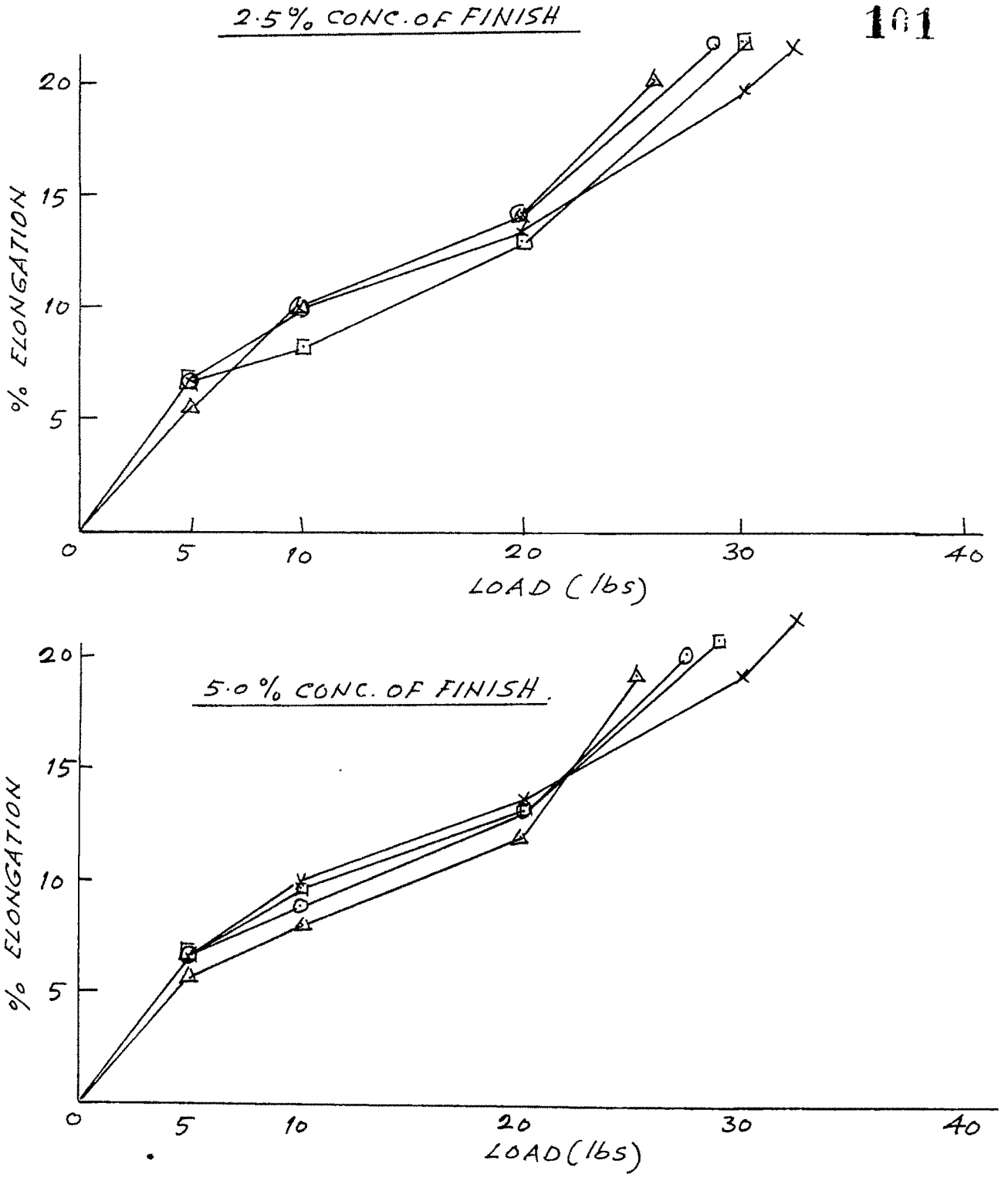
TABLE 14

PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS (POLYESTER/COTTON FABRIC D) WARP

% Conc. of Finish			Percentage Elongation					
Acrylic		DMDHEU	Loads (lbs) 5	10	20	30	EBP	BP (lbs)
0.5	+	2.0	5.7	10.3	14.0	-	20.3	(25.7)
1.25	+	1.25	6.7	8.3	13.0	21.3	21.8	(30.0)
2.0	+	0.5	6.7	10.0	14.0	-	21.7	(28.7)
1.0	+	4.0	5.7	8.0	12.0	-	19.3	(25.3)
2.5	+	2.5	6.7	9.7	14.0	-	20.7	(28.4)
4.0	+	1.0	6.7	9.3	14.3	-	20.3	(27.6)
Control			6.7	10.0	13.7	19.3	21.7	(32.3)

EBP : Elongation at breaking point.

BP : Breaking point.



X - CONTROL, △ - 1:4 OF ACRYLIC AND DMDHEU FINISH
□ - 1:1 OF ACRYLIC AND DMDHEU FINISH.
⊙ - 4:1 OF ACRYLIC AND DMDHEU FINISH

FIG. 29 PERCENTAGE ELONGATION AT VARIOUS LOADS OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS OF COMBINATION FINISHES (POLYESTER/COTTON FABRIC D)

similar proportion to acrylic finish had greater improvement in ease of ironing property. As such improvement in appearance rating was noticed with all the six variations of combination finishes. For fabric A treated with finish having 1:4 ratio of acrylic finish to DMDHEU finish, the appearance rating values after twenty four hours of recovery were higher, indicating the influence of DMDHEU on recovery from wrinkles.

The effects of different concentrations of combination finishes on polyester/cotton fabric B were found to improve appearance ratings of twenty four hours after wrinkling and after ironing at nylon setting except for the finish consisting of 4.0 percent acrylic finish + 1.0 percent DMDHEU finish where the changes were slight. Maximum change was noticed with equal or more proportion of DMDHEU to acrylic finish at 2.5 percent concentration, and with equal proportion of both the finishes at 5.0 percent concentration.

In the case of 50/50 polyester /cotton fabric D finishes having 1:4 and 1:1 of acrylic finish to DMDHEU finish served better to improve appearance rating of twenty four hours after wrinkling. The data further indicated that, in general, finishes of 5.0 percent concentration have helped more than 2.5 percent concentration finishes. Fabric D treated with finishes having higher or equal proportion of DMDHEU finish to acrylic finish at 5 percent concentration had the highest appearance ratings after ironing at nylon setting.

TABLE 15

APPEARANCE RATING OF FINISHED FABRIC SAMPLES

(COTTON FABRIC A)

% Conc. of Finish			Ratings			
Acrylic		DMDHEU	a	b	c	d
0.5	+	2.0	1.5	2.5	2.5	4.0
1.25	+	1.25	2.0	2.0	2.5	4.0
2.0	+	0.5	2.0	2.0	2.5	3.0
1.0	+	4.0	2.0	2.5	2.5	4.0
2.5	+	2.5	2.0	2.0	2.0	3.5
4.0	+	1.0	2.0	2.0	2.0	3.0
Control			1.0	1.0	1.0	2.0

a : After wrinkling.

b : Twenty four hours after wrinkling.

c : After ironing with cold iron.

d : After ironing at nylon setting.

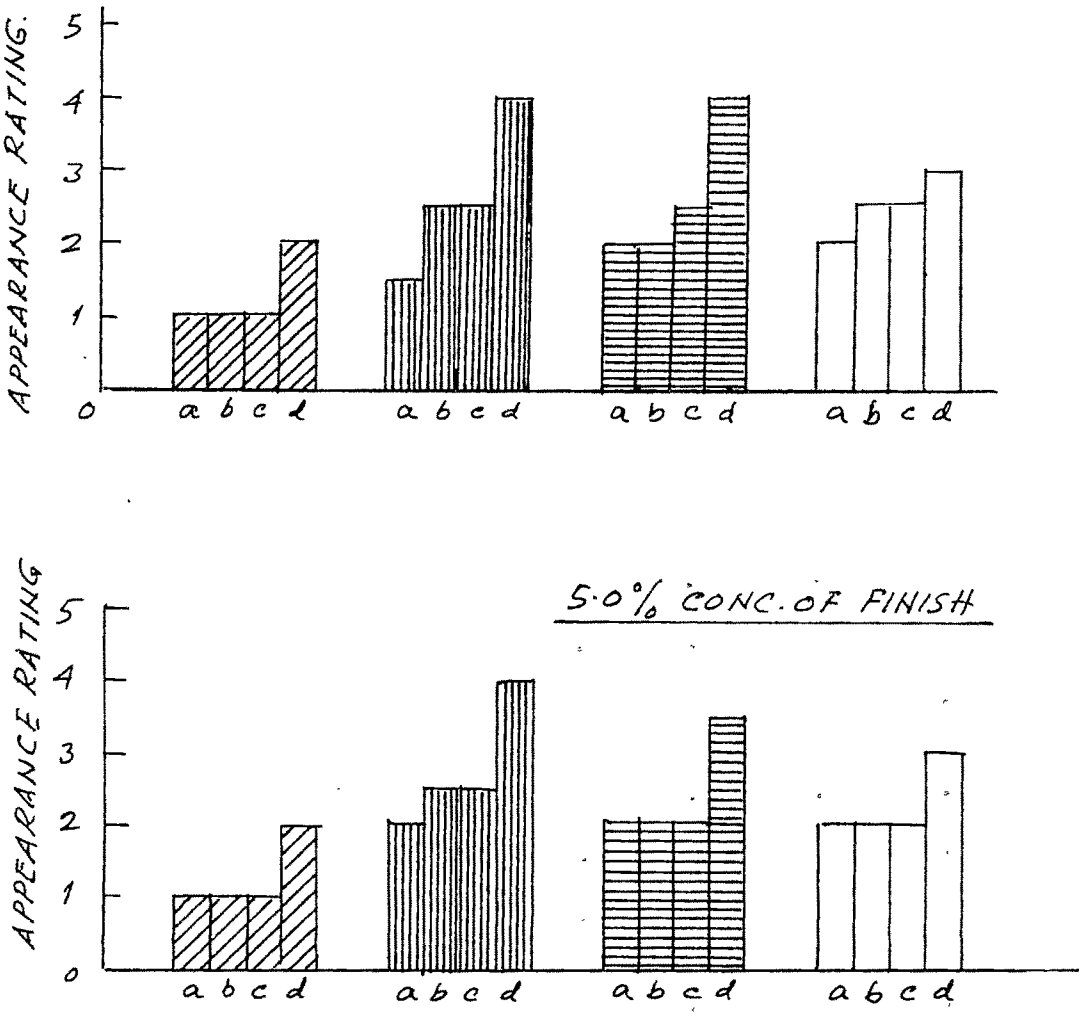


FIG.30 APPEARANCE RATING OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS OF COMBINATION FINISHES (COTTON FABRIC A)

TABLE 16

APPEARANCE RATING OF FINISHED FABRIC SAMPLES

(POLYESTER/COTTON FABRIC B)

% Conc. of Finish			Ratings			
Acrylic		DMDHEU	a	b	c	d
0.5	+	2.0	2.0	3.0	3.0	5.0
1.25	+	1.25	2.0	3.0	3.0	5.0
2.0	+	0.5	2.0	2.5	3.0	4.5
1.0	+	4.0	2.0	3.0	3.0	4.5
2.5	+	2.5	2.0	3.0	3.0	5.0
4.0	+	1.0	2.0	2.0	2.0	4.0
Control			2.0	2.0	2.0	4.0

a : After wrinkling.

b : Twenty four hours after wrinkling.

c : After ironing with cold iron.

d : After ironing at nylon setting.

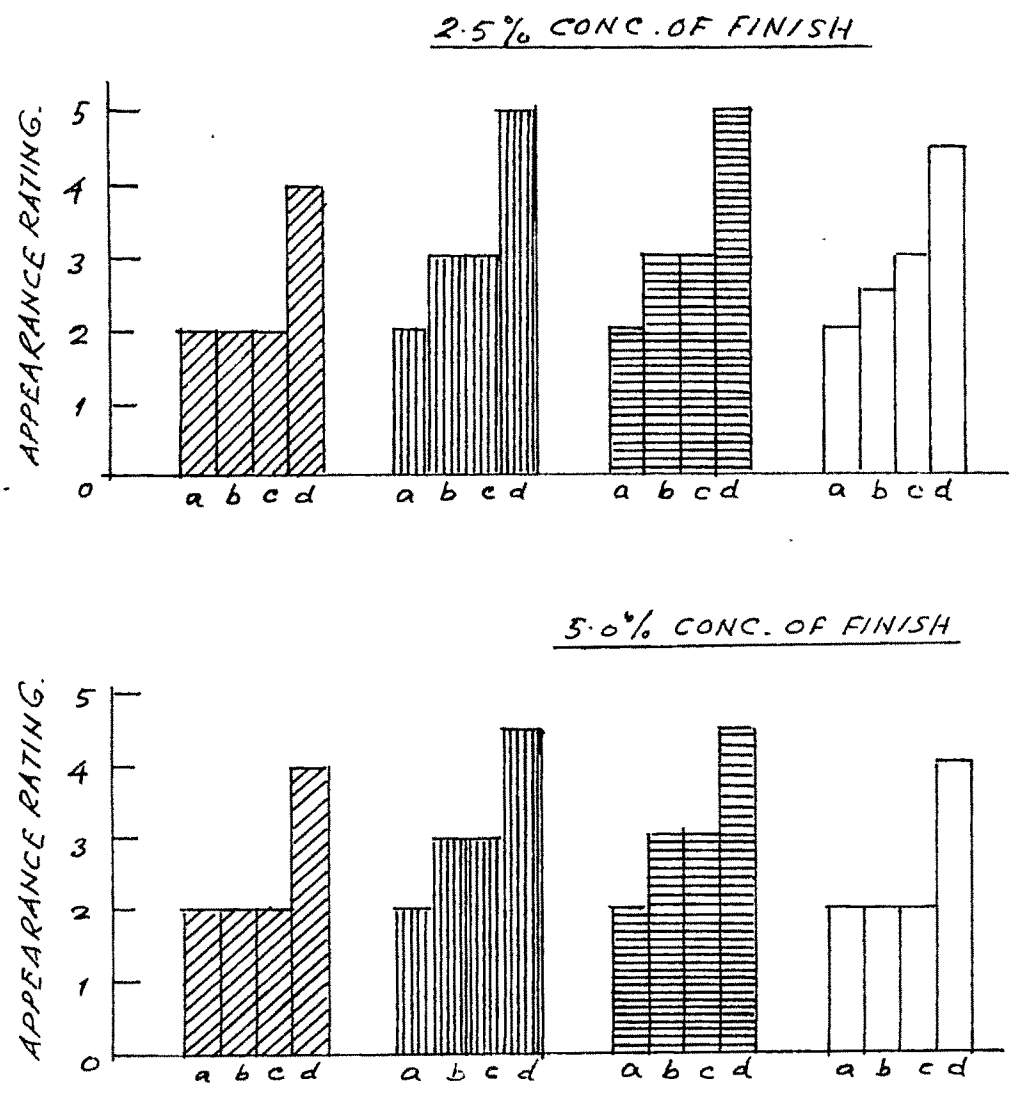


FIG. 31 APPEARANCE RATING OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS OF COMBINATION FINISHES (POLYESTER/COTTON FABRIC B)

TABLE 17

APPEARANCE RATING OF FINISHED FABRIC SAMPLES

(POLYESTER/COTTON FABRIC D)

% Conc. of Finish Acrylic		DMDHEU	Ratings a	b	c	d
0.5	+	2.0	2.5	3.5	3.5	4.0
1.25	+	1.25	2.5	3.5	3.5	4.0
2.0	+	0.5	2.0	3.0	3.0	4.0
1.0	+	4.0	2.0	4.0	4.0	5.0
2.5	+	2.5	2.0	3.5	3.5	5.0
4.0	+	1.0	2.0	3.0	3.0	4.0
Control			2.0	3.0	3.0	3.5

a : After wrinkling.

b : Twenty four hours after wrinkling.

c : After ironing with cold iron.

d : After ironing at nylon setting.

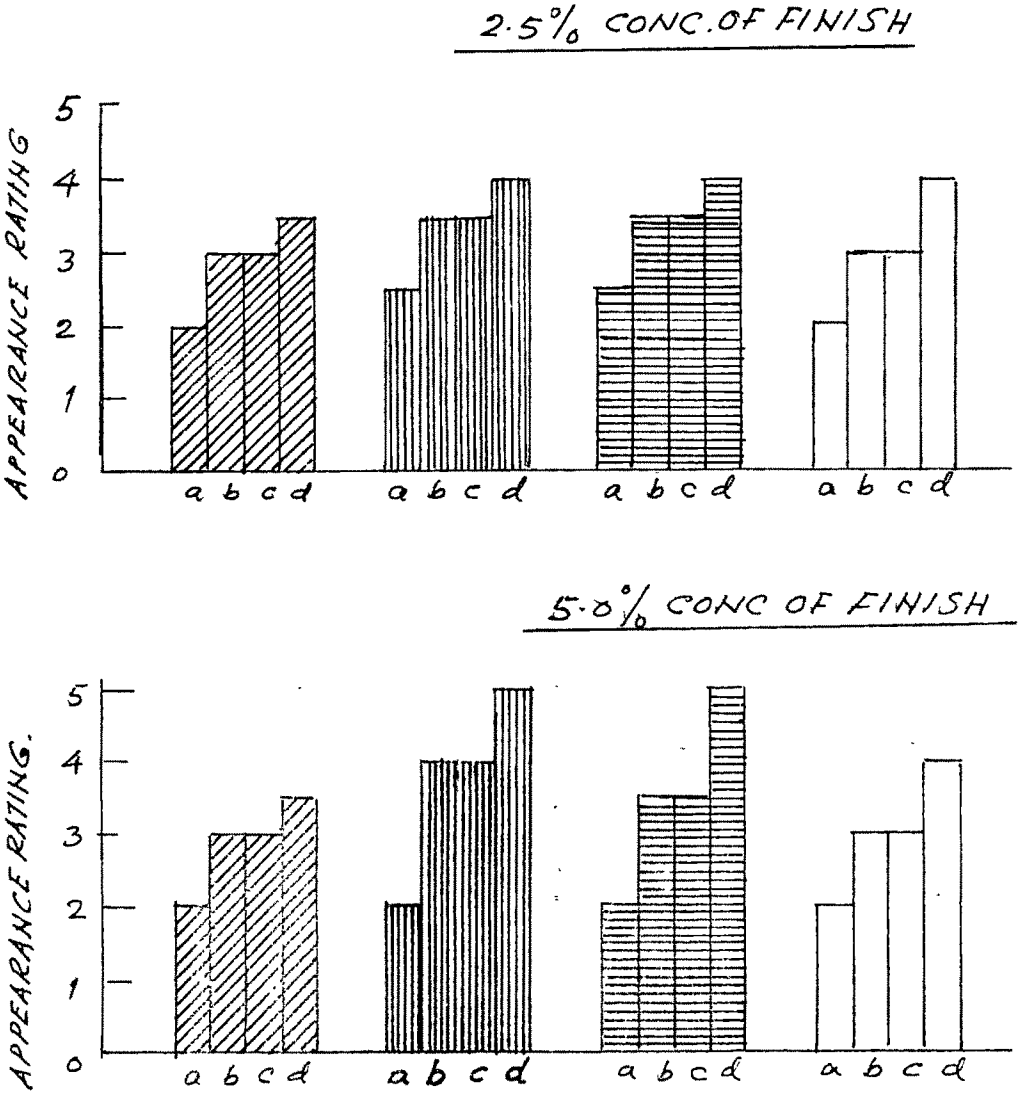


FIG. 32 APPEARANCE RATING OF FINISHED FABRICS AT DIFFERENT CONCENTRATIONS OF COMBINATION FINISHES (POLYESTER/COTTON FABRIC D)

It is possible that under the mild conditions used, the influence of the thermoplasticity of acrylic finish was not observed. The acrylic finish was also not so reactive as DMDHEU finish, and its influence was unnoticeable.

9. Relationship Between Wrinkle Recovery and Tensile Strength at Varying Concentrations of Finished Fabrics

The relationship between wrinkle recovery and tensile strength has been shown as bar diagrams in Figures 33 to 38 and the data has been given in Table 18. In order to judge the influence of a particular finish the bar diagrams have been plotted by keeping the concentration of one finish as relatively steady with variation in concentration of the other finish.

With fabric A by keeping acrylic finish relatively constant (Figure 33), the changes in wrinkle recovery and changes in strength can be attributed to the variation in DMDHEU. By comparing T_2 Vs T_1 and T_5 Vs T_4 Vs T_3 it has been seen that wrinkle recovery improvements due to DMDHEU finish were accompanied by loss in strength. Similarly, keeping DMDHEU relatively constant (Figure 34), the changes in wrinkle recovery and tensile strength can be observed as due to variation in acrylic finish. When T_2' Vs T_1' and T_5' Vs T_4' Vs T_3' were compared, it was observed that there is recovery from the loss in strength with the increasing presence of acrylic finish alongwith improvement in wrinkle

TABLE 18

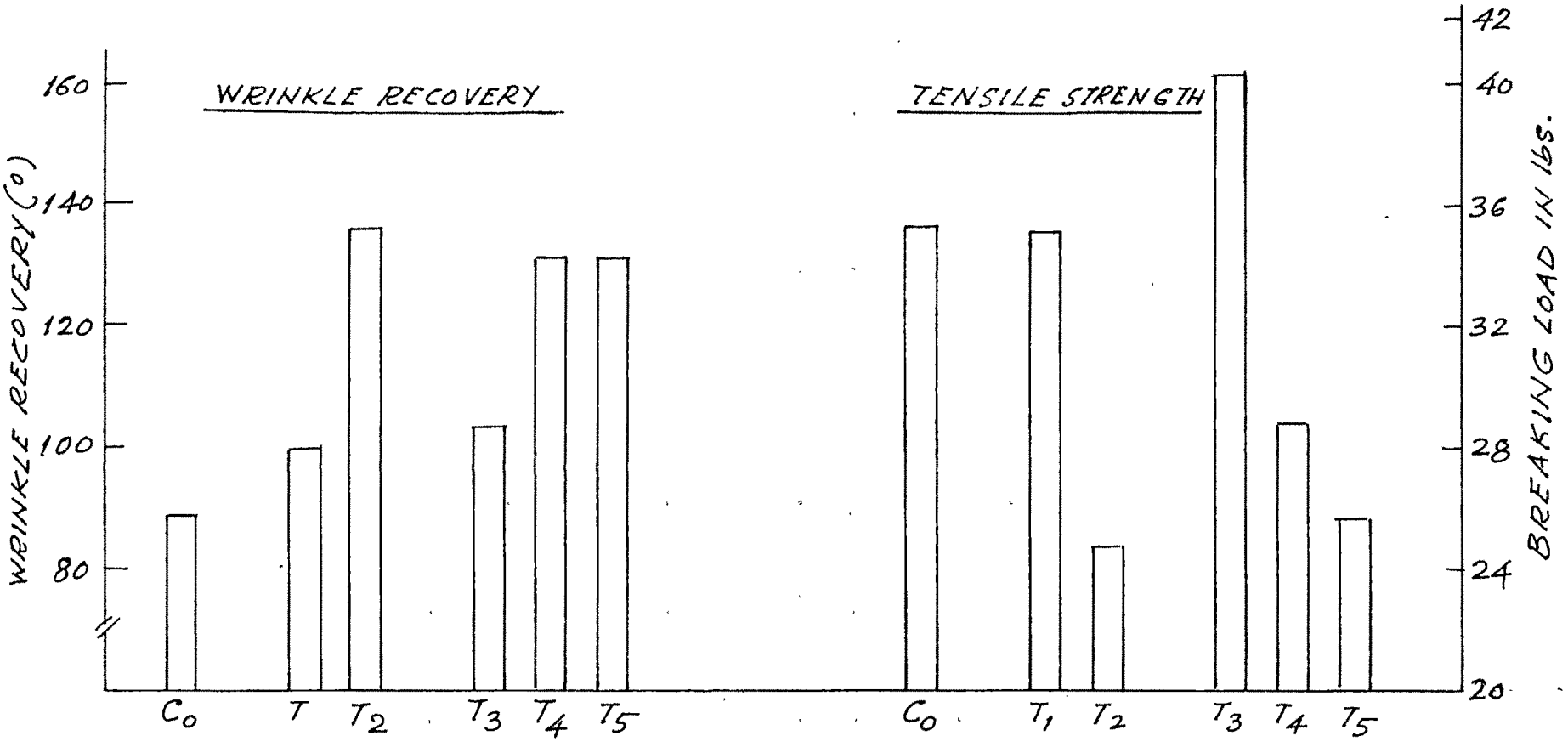
RELATIONSHIP BETWEEN WRINKLE RECOVERY AND TENSILE STRENGTH AT VARYING CONCENTRATIONS OF FINISHED FABRICS

% Conc. of Finish Acrylic		DMDHEU	Fabrics	Wrinkle Recovery (°) (Warp) A	B	D	Tensile Strength in Lbs. (Warp) A	B	D
0.5		-		100.3	143.8	-	35.0	39.0	-
0.5	+	2.0		135.9	151.1	145.9	24.6	37.2	25.7
1.25		-		103.7	147.4	-	40.3	39.5	-
1.25	+	1.25		131.3	152.1	149.0	28.8	42.2	30.0
1.0	+	4.0		131.0	152.8	157.9	25.5	37.6	25.3
-		0.5		115.9	132.1	-	23.3	36.0	-
2.0	+	0.5		135.9	151.1	141.3	24.6	37.2	28.7
-		1.25		120.1	140.8	-	22.0	35.4	-
1.25	+	1.25		131.3	152.1	149.0	28.8	42.2	30.0
4.0	+	1.0		127.0	147.6	146.9	30.4	39.1	27.6
Control				89.3	128.4	128.4	35.2	39.1	32.3

Fabric A : Cotton

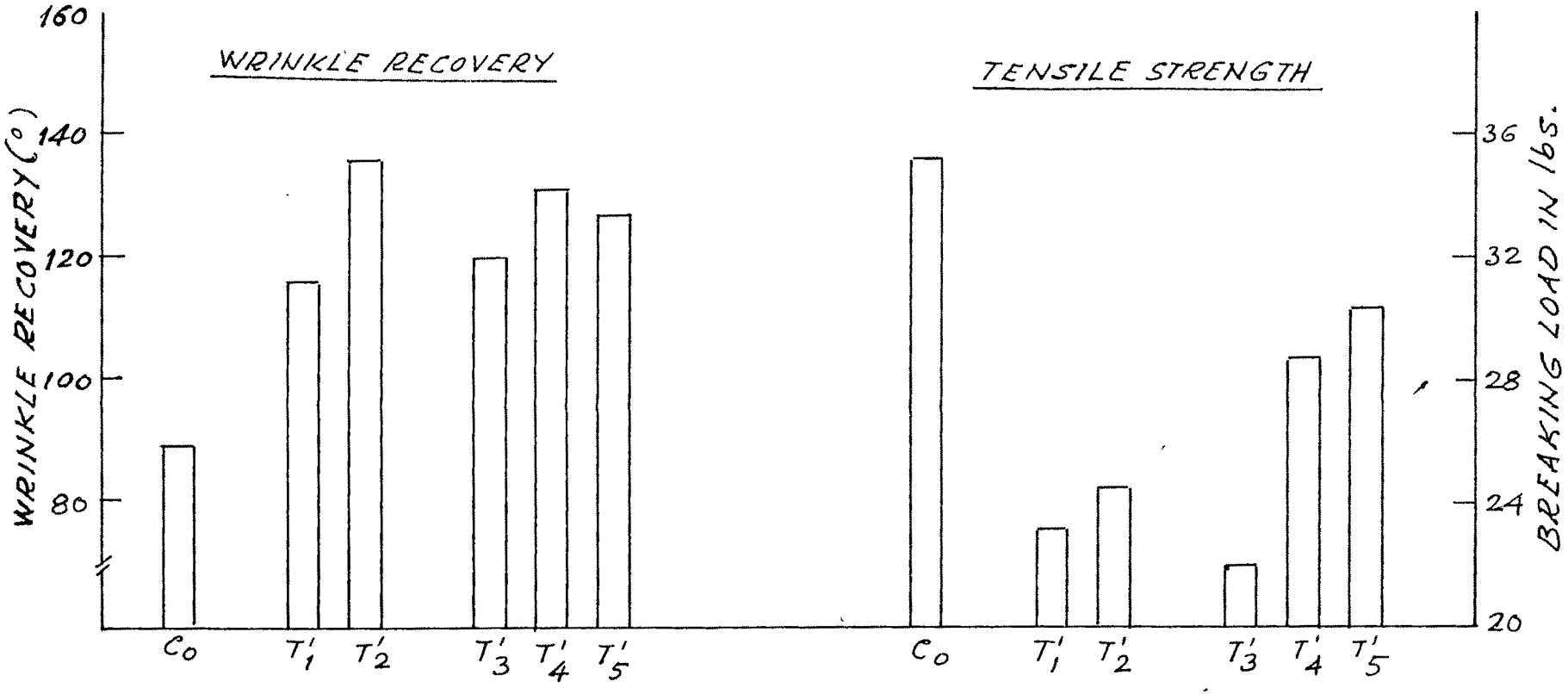
Fabric B : 67/33 Polyester/Cotton.

Fabric D : 50/50 Polyester/Cotton



C_0 - CONTROL, T_1 - 0·5% AC, T_2 - 0·5% AC + 2·0% DM, T_3 - 1·25% AC, T_4 - 1·25% AC + 1·25% DM.
T_5 - 1·0% AC + 4·0% DM. AC - ACRYLIC FINISH, DM - DMDHEU FINISH

FIG. 33 RELATIONSHIP BETWEEN WRINKLE RECOVERY AND TENSILE STRENGTH AT VARYING CONCENTRATIONS OF FINISHED FABRICS. (COTTON FABRIC A)



C_o - CONTROL, T_1' - 0·5% DM, T_2' - 2·0% AC + 0·5% DM, T_3' - 1·25% DM, T_4' - 1·25% AC + 1·25% DM. T_5' - 4·0% AC + 1·0% DM. AC - ACRYLIC FINISH, DM - DMDHEU FINISH

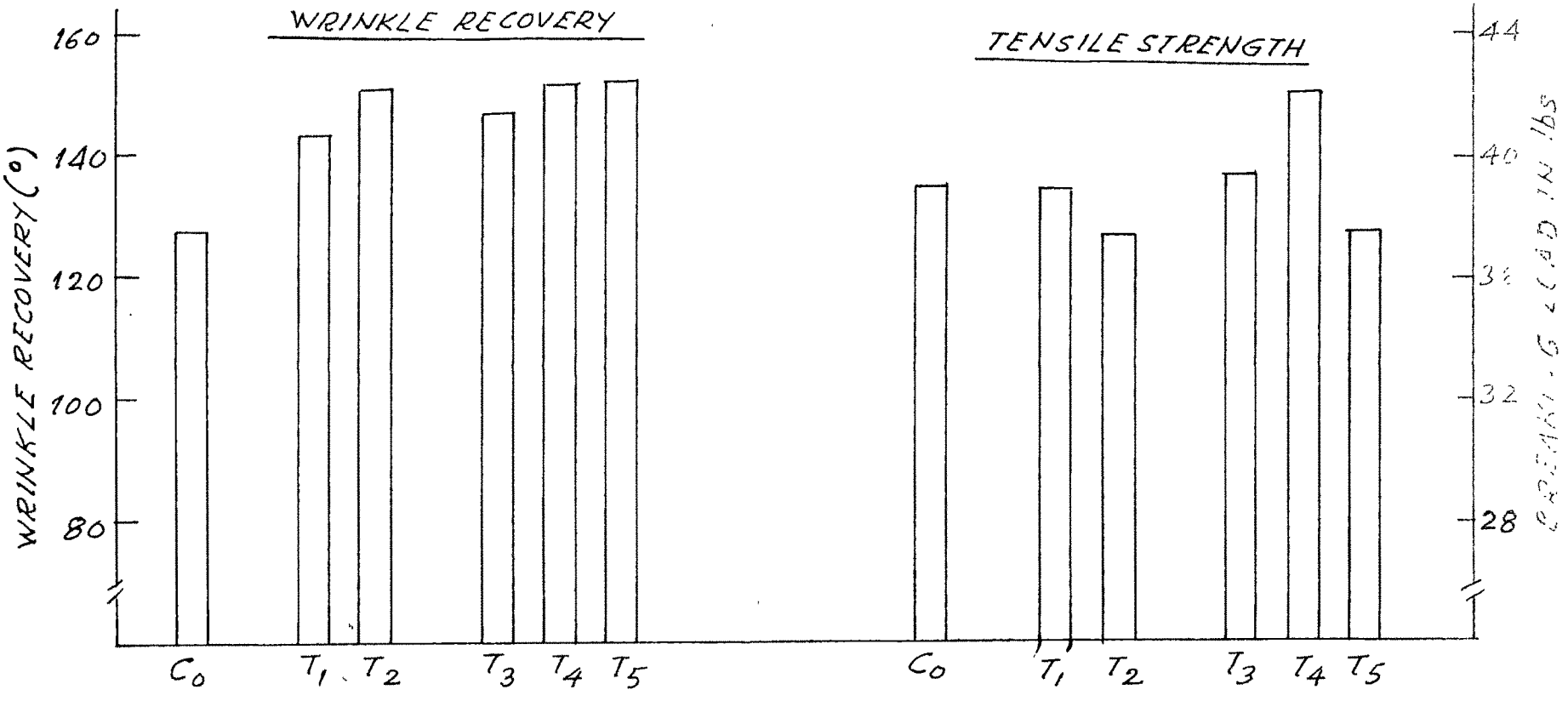
FIG. 34 RELATIONSHIP BETWEEN WRINKLE RECOVERY AND TENSILE STRENGTH AT VARYING CONCENTRATIONS OF FINISHED FABRICS. (COTTON FABRIC A)

recovery.

Similarly a comparison of the bar diagrams for polyester/cotton fabric B, (Figure 35) (T_2 Vs T_1 and T_5 Vs T_4 Vs T_3) indicated a steady rise in wrinkle recovery and a loss in tensile strength with the increasing presence of DMDHEU finish. Increasing presence of acrylic finish (T_2' Vs T_1' and T_5' Vs T_4' Vs T_3') helped to improve wrinkle recovery (Figure 36) and to retain or to improve tensile strength. The smaller variations in changes brought by these two finishes for fabric B as compared to fabric A could be due to the influence of polyester content in the fabric.

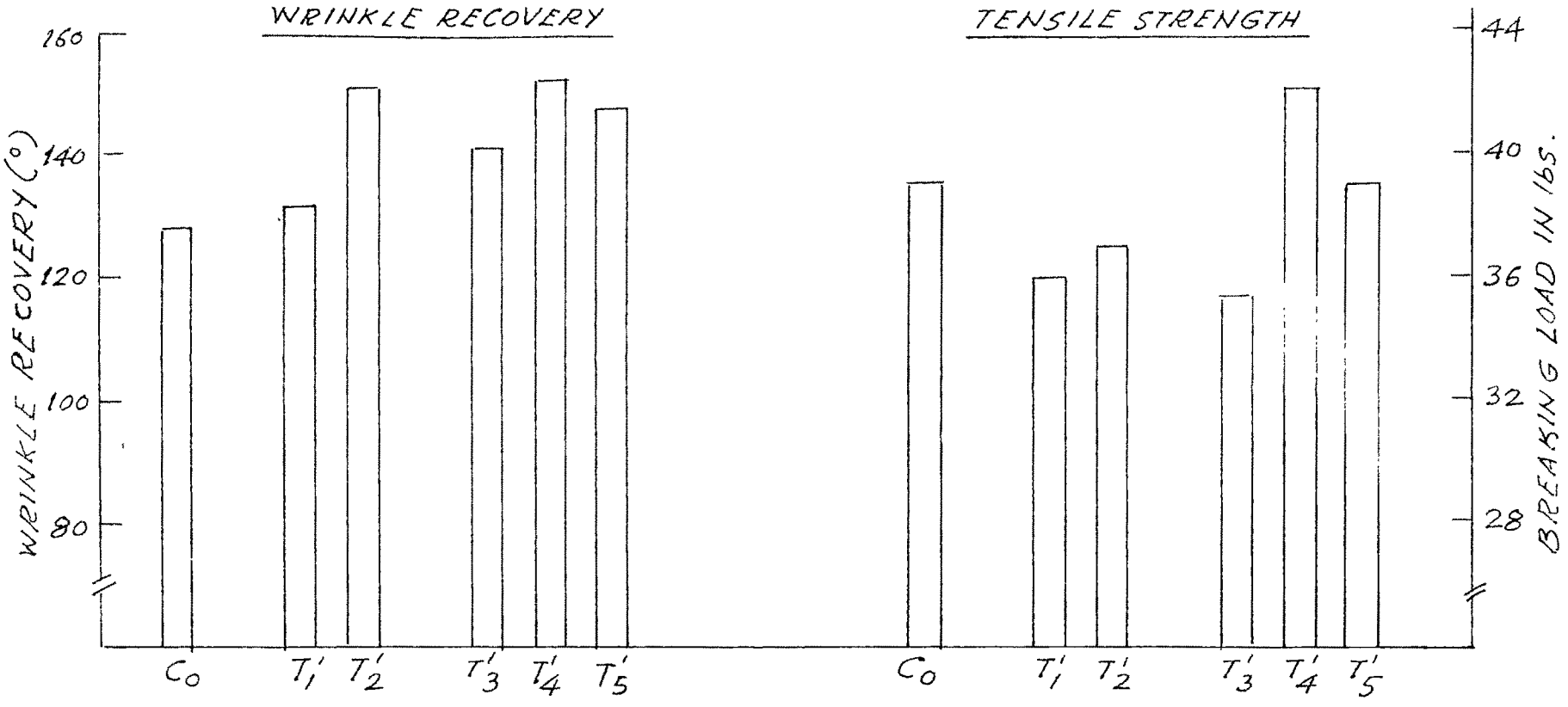
The relationship between wrinkle recovery and tensile strength for 50/50 polyester/cotton fabric D has been illustrated with bar diagrams in Figures 37 and 38. When T_5 Vs T_4 Vs T_2 and T_5' Vs T_4' Vs T_2' were compared it indicated greater increase in wrinkle recovery so also loss in strength with increasing presence of DMDHEU than that with acrylic finish. This is due to the DMDHEU finish which cross-links the cellulose chains and introduces rigidity. The acrylic finish in increasing presence with DMDHEU finish helps to increase wrinkle recovery and assists in maintaining the strength.

Finishing with equal proportions of both the finishes helps not only for cotton but also for cotton and polyester blend fabrics. The effect of each of the finish is supplementary, though by different mechanism.



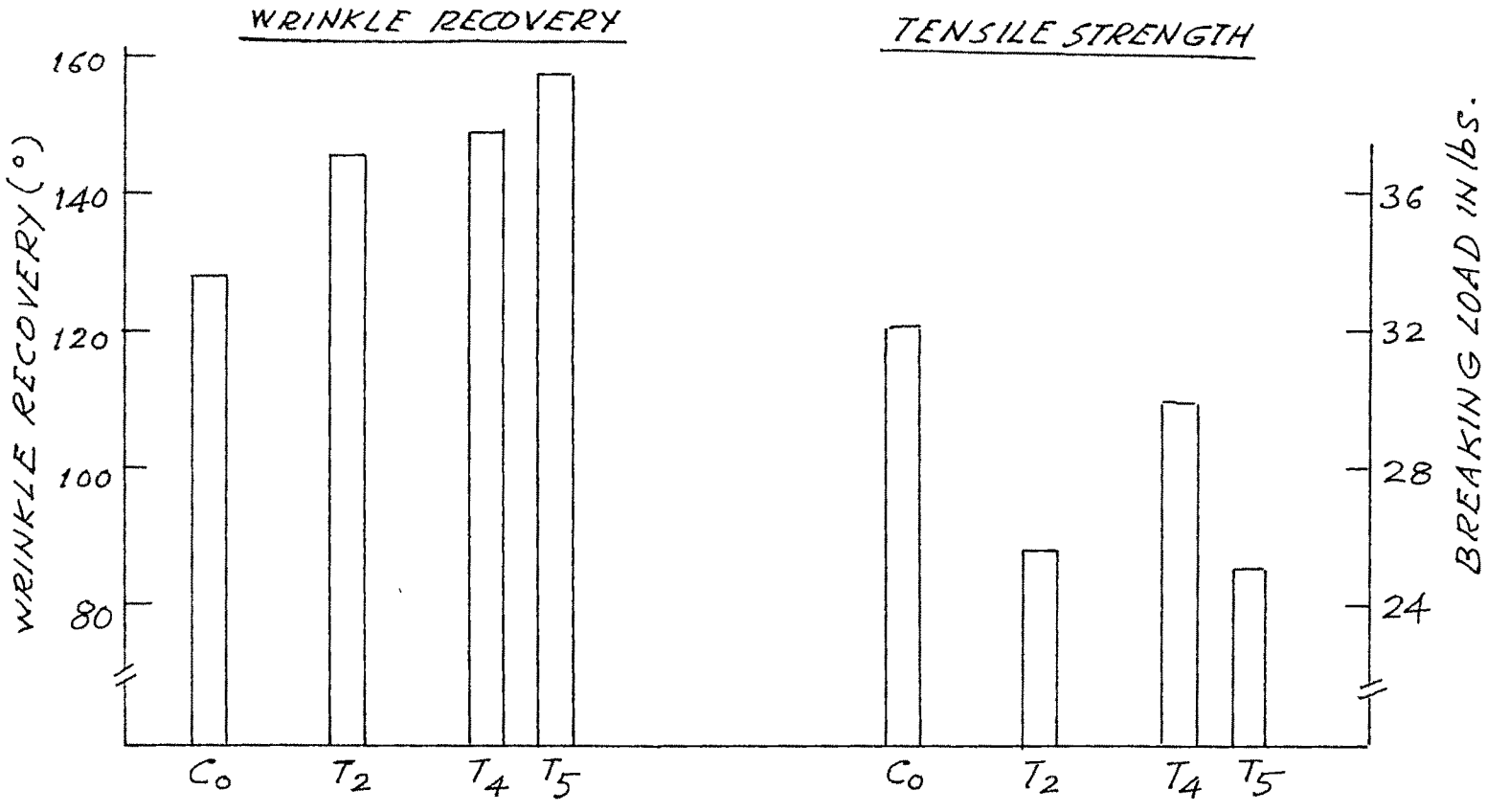
C_0 - CONTROL, T_1 - 0·5% AC, T_2 - 0·5% AC + 2·0% DM, T_3 - 1·25% AC, T_4 - 1·25% AC + 1·25% DM, T_5 - 1·0% AC + 4·0% DM. AC - ACRYLIC FINISH, DM - DMDHEU FINISH

FIG. 35 RELATIONSHIP BETWEEN WRINKLE RECOVERY AND TENSILE STRENGTH AT VARYING CONCENTRATIONS OF FINISHED FABRICS. (POLYESTER/COTTON FABRIC B)



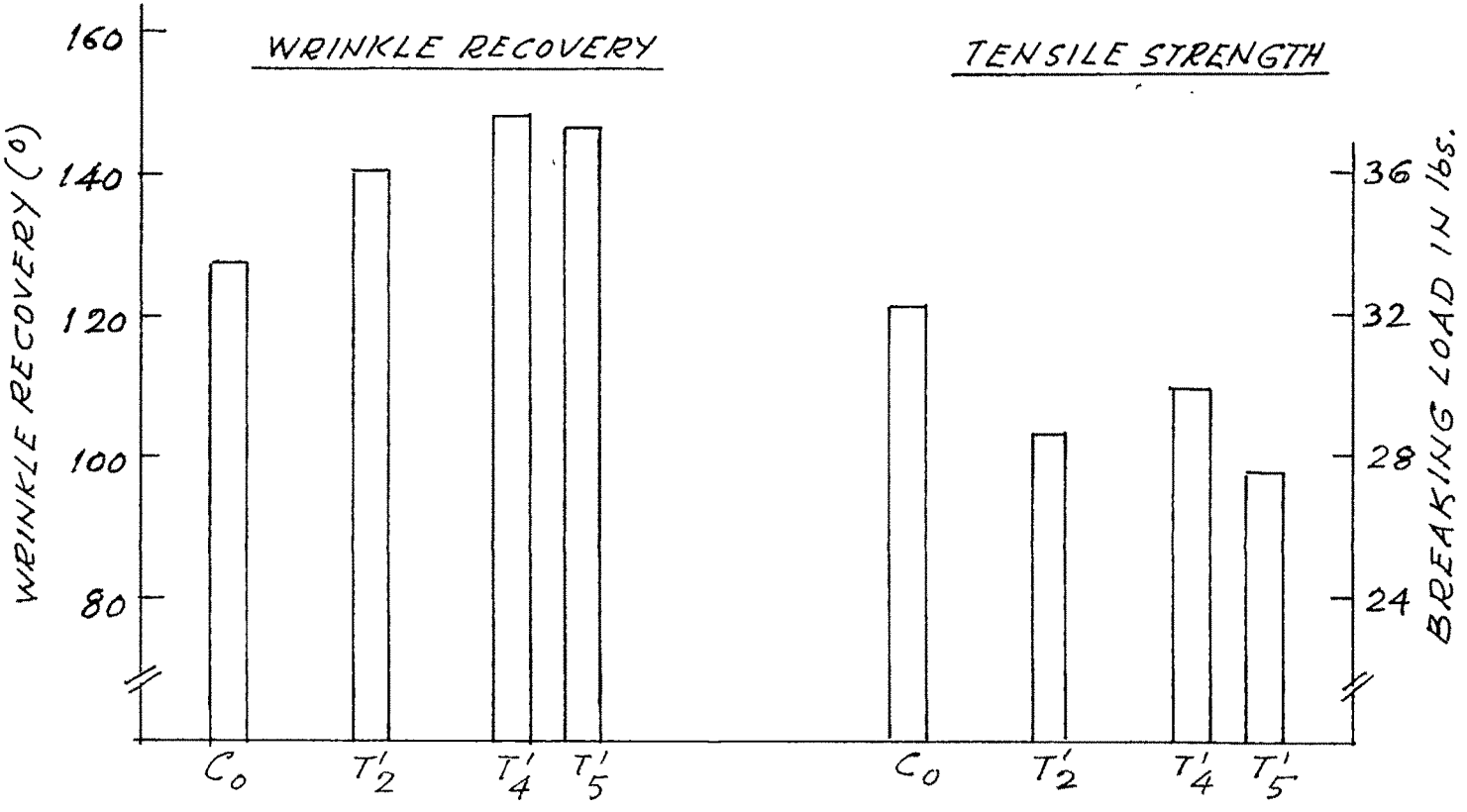
C_0 - CONTROL, T_1' - 0·5% DM, T_2' - 2·0% AC + 0·5% DM, T_3' - 1·25% DM, T_4' - 1·25% AC + 1·25% DM.
T_5' - 4·0% AC + 1·0% DM. AC - ACRYLIC FINISH, DM - DMDHEU FINISH

FIG. 36 RELATIONSHIP BETWEEN WRINKLE RECOVERY AND TENSILE STRENGTH AT VARYING CONCENTRATIONS OF FINISHED FABRICS (POLYESTER/COTTON FABRIC B)



C_0 - CONTROL, T_2 - 0·5% AC + 2·0% DM, T_4 - 1·25% AC + 1·25% DM,
T_5 - 1·0% AC + 4·0% DM. AC - ACRYLIC FINISH, DM - DMDHEU FINISH

FIG. 37 RELATIONSHIP BETWEEN WRINKLE RECOVERY AND TENSILE STRENGTH AT VARYING CONCENTRATIONS OF FINISHED FABRICS (POLYESTER)COTTON FABRIC D)



C_0 - CONTROL, T_2' - 2·0% AC + 0·5% DM, T_4' - 1·25% AC + 1·25% DM, T_5' - 4·0% AC + 1·0% DM.
AC - ACRYLIC FINISH, DM - DMDHEU FINISH

FIG. 38 RELATIONSHIP BETWEEN WRINKLE RECOVERY AND TENSILE STRENGTH AT VARYING CONCENTRATIONS OF FINISHED FABRICS. (POLYESTER/COTTON FABRIC D)