EVALUATION OF FIBER BLEND SPINNING IN EGYPTIAN COTTON INDUSTRY

By

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Abstract:

The aim of this work is to evaluate the spinning performance of most egyptian cotton varities, as well as to declare the manner of proper selection of cotton component in blending with new MISR polyester fibers. For the carded phase, cottons like G31, G70, and G75 were chosen and counts of Ne 20, 30 and Ne 40 are produced at blend levels 50c/50p, 33c/67p, 25c/75p. In addition,a study on blending of G70,G75 and G77 in a combed phase for spinning counts of Ne 40, 50 and 60 at blend levels 67c/33p, 50c/50p and 33c/67p is also reported.

The results declared that, there is a good scope for blending these cottons with polyester fiber. Also, it was found that the cotton fiber properties, method of preperation as carded or combed and yarn size do affect the quality of blended yarn at the blend levels produced.

1. Introduction:

Blending of fibers, of different types and origin, to get textile materials is an age old practice. In general, this is done for economic considerations and to improve the properties to suit end use requirements. In the present time, blended textile have become a major portion of the commercial production. The increase of world fiber production from 1973 to 1980 is about 30 %, this indicates the growth of blended yarn production /1,2/.

In egyptian textile industry, blending of cotton with synthetic fibers is not a new phenomenon, but prior to 1980, polyester staple fibers used for blending with cotton fibers to be mainly imported from Japan and other foreign countries. since that time, the production of MISR polyester is commercially introduced for the first time in Egypt at Kafr El-Dawaar MISR RAYON.

Several Industrial laboratories conducted studies on blending of this new polyester fiber with egyptian cotton fibers. Most of investigations have been made on a small scale and the conclusions of each study have largly remained straightforward for the particular cotton fiber type also for a

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limited blend proportions. On the other hand, textile research workers began to experiment and determine the spinning performance of blending MISR polyester with egyptian cotton fibers.

The cohesion properties of cotton/ polyester blends in roving and slivers have been studied /3/. Other work /4/, has investigated the effect of cotton fiber properties , as fiber length, fineness and strength on the quality of 50c/50p carded cotton-polyester blended yarns.

In the present work, the specific objective is to study the effect of various types of egyption cotton fibers, cotton-polyester blend levels and yarn linear density on the quality of two - component blended yarns. In addition, to evaluate how MISR polyester staple fiber perform in blends with all cotton varieties. The investigation was carried out in a carded and a combed phase.

2.Experimental work:

2.1. Method and materials:

i) Fibers:four types of egyptian cotton, Giza 31, Giza 70, Giza 75, Giza 77 were used in the present study for blending with MISR polyester staple fiber. The general fiber properties of various cottons used in the study are given in table (1.1). Also, it can be seen that MISR polyester fiber characteristics in table (1.2).

Table (1.1): Fiber properties of egyptian cotton used for blending.

Property	Egyptian cotton fiber			
	Giza 31	Giza 70	Giza 75	Giza 77
1. Cotton grade	G	G	G/FG	G/FG
2. Fiber length (mm):				
" " at 25%	29	32.5	29.5	34.7
" " " 50%	13.6	15.7	14.4	16.7
Uniformity %	47	46	47	48
3. Fiber fineness (μg/inch):				
Micronaire reading	3.8	4.2	4.5	4
4. Fiber strength:				
Breaking Strength (lb/inch)	91778	101509	105833	107996
Pressley Index	8.5	9.3	9.8	10

Table (1.2): Properties of MISR polyester fiber

Fiber length (mm)	38.5 ± 1
Denier	1.4 ± 0.09
Tenacity (g/den)	5.9 ± 0.3
Shrinkage (%)	4.2 ± 1.2
No. of crimps/cm	9.0 ± 2
Regain percentage(%)	0.6

ii)Yarn production: all of these fibers were spun into different yarn counts at ring spinning frame as a single component yarns with constant twist multiplier of 3.7 .In addition,each of cotton fiber component have been blended with polyester at drawing process and three blend levels were chosen. The construction details of yarn preparation is given in table (2).

Table (2): Construction details of carded and combed blends.

Cotton type	G31	G70	G77	G70	G75	G77
yarn count(Ne)	20	30	40	40	50	60
Blend composition:						
	i)for carded phase			ii)for combed phase		
100c	x	x	x	x	x	x
67c/33p	-	-	-	x	x	x
50c/50p	x	x	x	x	x	x
33c/67p	x	x	x	x	x	x
25c/75p	x	x	x	-	-	-
100p	x	x	x	x	x	x

ii)Spin plan and machine employed: The classical preparation routine was adapted for processing the two components, cotton and polyester fibers.

Table (3.1) Spin plan and machine employed for 100% carded cotton, polyester and their blends.

Operation	Infeed Ne	Doubling	Draft	Delivery Ne	Machine type
i) for 100% carded cotton yarns					
1. Blow room	-	-	-	0.00128	Hergeth
2. card	0.00128	1	109	0.14	Toyoda H.P. Card M/C.
3.Drawing I	0.14	8	7.86	0.137	Versamatic
Drawing II	0.137	8	7.86	0.135	Sacolewell.
ii) for 100% polyester and c/p blends					
1.Blowing room	-	-	-	0.0168	Short line.
2.Card *	0.0168	1	83	0.14	Textima H.P. Carding M/C
3.Drawing I	0.14	24	24	0.14	Blending M/C
Drawing II	0.14	8	7.7	0.135	Schlafhorst
iii) for all fibers, the above sequence followed by speed frame and ring spinning frame.					
4.Roving	0.135	1	7.4	1	Textima with
			9.26	1.25	Sussen draft system.
5.R.spinning	1	1	20	20	Textima with
	1.25	1	24	30	SKF draft
	1.25	1	32	40	system.

*Fleese blender, 4 vertical heads (D=4x6), draft v=6 plus one horizontal head (D=4),draft v=4.

For both carding and combing processing phase, cotton and polyester fibers were blended at draw- ing frame. In this manner, seperate lines for polyester and cotton were used for openning, cleaning and carding. Therefore, trash and neps could be removed from cotton efficiently and poly- ester fiber could be processed without damaging. The desired blend levels were achieved easily by varying the relative number of cotton and poly- ester slivers fed. Machine employed and data regarding doubling, counts, draft and production are indicated in tables (3.1) and (3.2).

Table (3.2) Spin plan and machine emoyed for 100% combed cotton, polyester and their blends.

Operation	Infeed Ne	Doubling	Draft	Delivery Ne	Machine type
i) for combed cotton yarn Giza75					
1&2.Blow room with carding.	-	-	112	0.14	Trutzschler line.
3.Drawing	0.14	8	10.15	0.18	Platt prep.
4.Sliver lap	0.18	20	1.05	62g/m	system.
5.Combing	62g/m	6	70.4	0.14	
6.Drawing I	0.14	8	8,10.15	0.14,0.18	Platt-
Drawing II	.14,.18	8	8	0.14,0.18	Sac.
ii) for cotton yarn Giza 70 and Giza 77					
1.Blow room	-	-	-	420g/m	Rieter line.
2.Carding	420g/m	1	100	0.14	Conven.Card
3.Drawing	0.14	5	4.6	0.13	
4.Super lap	0.13	32	2.24	65g/m	Combing prep.
5.Combing	65g/m	4	52.7	0.15	Whitin system.
6.Drawing I	0.15	8	7.32,9.68	0.14,0.18	
Drawing II	.14,.18	8	8	0.14,0.18	
iii) for 100% polyester yarn					
1,2.Blow room with card.	-	-	112	0.14	Short line for synthetic fibers
6.Drawing I	0.14	8	8,10.15	0.14,0.18	
Drawing II	.14,.18	8	8	0.14,0.18	
for blends					
6.Drawing I	.14,.18	6	6	0.14,0.18	
Drawing II	.14,.18	8	8	0.14,0.18	
for all fibers, The above sequence followed by roving and ring spinning					
7.Roving	0.14,0.18	1	10	1.4,1.8	Platt-Sac.
8.R spinning	1.4	1	28.75	40	
	1.8	1	27.7	50	Spin-D-Matt.
	1.8	1	33.3	60	

*Noil combing percentage 20%.

2.2 Measurements:

Details of various tests for mechanicalproperties of fibers and yarns are kept according to ASTM Standard and instruction details of the instruments. Fiber tests include fiber bundle strength at zero guage on pressley strength tester. Fiber length, using digital fibrograph and fiber fineness (µg/inch) using Sheffield Micronair.Yarns were examined for yarn twist on Zweigle twist-meter, yarn count on Autosorter, yarn strength on Tensomat Strength Tester and irregularity on Uster Evenness Tester.

3. Results and Discussions:

3.1 Yarn properties of combed cotton/polyester blends:

i) The strength characteristics: The single-end strength, yarn tenacity, count strength product (CSP) and yarn breaking extension for combed blends counts Ne 40, Ne50, Ne 60 are plotted in figures (1 , 2, and 3) respectively.

Single-end strength: The yarn tenacity (g/ tex) gradually decreases as the proportion of cotton decreases up to 50c/50p, then increases again as the polyester content increased. Also, it is evident that the single yarn strength for G77/ PES blends being less than that of the 100% indvidual component. The same trend has been observed for G70/PES and G75/PES blends except yarns with blend ratio 33c/67p. This blend level does show a higher value of yarn strength than the lower component strength (100% cotton).

Count Strength Product (CSP): It can be seen from the curves that CSP for all cotton/polyester blends being less than that of the indvidual components. The cotton fiber Giza 77 gives stronger yarns than Giza 75. The difference in yarn tenacity (g/tex) and the CSP is highly significant across the range of blend levels (100c to 50c/50p), while the deviation is considerably reduced when the proportion of polyester in the blend is above 50%. Also, Giza 77 combed cotton show much superiour strength values in blends with MISR polyester staple fiber than the blends cont- aining Giza 70 cotton fibers.

Yarn extension at break: The breaking extension of the yarns is plotted in figures (1.3), (2.3) and (3.3) for three yarn groups. For all combed cotton blends, elongation was the lowest for 100% cotton, highest for 100% polyester. As expected, the breaking elongation increases with increase in proportion of polyester fibers. The results indicate that blends of Giza 70 and Giza 75 with polyesrer have recorded higher breaking extension than blends containing Giza 77.

ii) Yarn Irregularity: The test results of yarn irregularity was measured by Uster evenness tester for combed blends. The effect of blend composition, cotton fibers and yarn count is shown in figures (1.4), (2.4) and (3.4) . Yarn uniformity was best for 100% combed yarns and blends up to 50c/50p than those for 100% polyester. The coefficient of variation (CV%) was similar for blends (67c/33p and 50c/50p) and the corresponding 100% combed cotton yarns. This is mainly due to the combing action of cotton fibers. Among all yarns Ne 40, 50 and 60, Giza 77 gave more uniform blended yarns than those of blends cotaining Giza 70 and Giza 75 resectively.

As a basis of comparison table (4) shows the 50% values of the Uster Statistics. The attianed Uster C.V% for different yarn count and blends are compared with the Uster Statistics level. It is evident that the yarn count Ne 40 recorded better uniformity while it will be seen that there is

a slight increase of Uster C.V% for Ne 50 and Ne 60 yarn higher than the Uster Statis- tics values.

Table (4) Uster CV% for combed blends.

Ratio	100%			33c/67p			100p		
Ne.	40	50	60	40	50	60	40	50	60
G75/PES	15.8	16.5	18.1	16.7	17.5	18.9			
G70/PES	15.9	17.4	17.5	16.0	17.6	18.7	16.9	18.3	19.6
G77/PES	14.5	15.6	16.7	15.6	16.6	17.9			
USTER STAISTICS AT 50%									
	15.7	15.8	16.2	16.5	17.0	18.3	16.6	17.7	19.5

3.2 Yarn properties of carded cotton/polyester blends:

i) Yarn tenacity and CSP: Consedering carded blends of MISR polyester fibers with Giza 31 (Danbbdara), Giza 70 and Giza 75. The results of various yarn tests of yarn tests are plotted gra- phically in figures (4 to 6). The results of yarn tenacity (g/tex) and CSP show the polyester yarn is substantialy stronger than the control yarn (100% cotton).

For 50c/50p blend ratio, yarn strength were lower for G75/PES blends than those for the correbsponding 100% cotton, while yarn strength were higher for blends containing Giza 31 cotton fiber and nearly equal for blends containing Giza 70. The 35c/65p and 25c/75p carded cotton/ polyester blended yarns are stronger than the control yarn for all yarn counts Ne 20 and 40.

Comparing blending with the same polyesterester content, Giza 31 gave stronger yarn in all cases than those of Giza 70 and Giza 75 respectively. The maximum differences between blended yarn tenacity are noticed at 50c/50p and ranged between 2-3 g/tex. This deviation become less at higher content of polyester as well as finer counts.

Yarn extension at break: The relationship between blend composition and breaking elongationof carded cotton/polyester blends are shown in figures (4.3, 5.3 and 6.3). It is clear that, the yarn elongation increses as the polyester content increse in blends.

iii) Yarn Irregularity: For carded blends, the effect of blend levels on yarn uni-formity is shown in figures (1.4, 1.5 and 1.6). It can be seen that up to a blend level 50c/50p, the addition of polyester had little change on the Uster CV% of all yarn groups, then the coefficient of variation improved when the polyester fiber content is increases more than 50%. Uster CV% is lower with blends containing Giza 75 followed by Giza 70 than with Giza 31 cotton fiber.

3.3 Comparison of combed blends and carded blends:

Among the plan of experiments, two egyption cotton fibers, Giza 70 and Giza 75, were blended with MISR polyester fiber under both of combed and carded phase with varying blend ratios, while yarn linear density 14 tex (Ne 40) and twist multiplier (α =3.7) were kept constant. In figure (7), it can be seen that, use of combed cotton generally improve the quality of blended yarn. For the same type of cotton fiber (Giza 70 or/and Giza 75), combed bleps gave higher srength than those for carded phase. The differences in yarn tenacity across 100c to 33c/67p blend ratios is highly significant. Also the curves indicate that yarn strengths for 100% combed cotton was siilar for cotton/polyester blends contianing 65% and 75% of polyester fiber in case of combed and carded phase respectively.

The behaviour of c/p blends containing combed and carded cotton fibers are represented again in figures (8,9 and 10). From the curves, it is clear that, for carded phase (G31/PES, G70/PES and G75/PES) most of blend levels higher than 50c/ 50p gave higher strengths than the lower component strength. These unlike the case of combed blends where yarns were weaker than either of the two- component yarn strengths. This trend is domenant with cotton fiber G77 of best best quality, while, for G75 nd G70 as combed fiber. The blend ratio 33c/67p are stronger than the control yarn.

4. Conclusions:

From the experimental results, the following conclutions can be drawn:

I) There is a good scope for blending egyptian cottons like Giza 31, Giza 70, Giza 75 and Giza 77 with new MISR polyestr staple fiber for producing yarns of counts from Ne.20 to Ne.60 depending on fiber properties of the two components.

II) A proper selection of cotton fiber is very important to achieve the desired yarn properties. Thus, use cottons like Giza 31 in carded phase, Giza 70 and Giza 75 in combed phase seems worthwhile, since the yarn produced with good quality.

III) For combed cotton/polyester blends, the results clearly show that :

- At blend levels lower than 50c/50p, the yarn properties were related to the cotton fiber properies.
- For most blend levels,except at 33c/67p, the tensile properties (g/tex,CSP) of blended yarns is lower than that for 100% cotton yarn. While for G77/PES blends, the yarn strength is lower for than that both 100% cotton and poly-ester yarns
- At blend level 33c/67p, the cotton fiber properties contributed less to yarn tenacity than the polyester fiber properties.

- For combed blends, higher blend ratio of polyester is recommended to posses their behaviour on the quality of yarns and fabrics.

IV) For carded cotton/polyester blends, further light on the aspect of carded phase has been thrown by the intrduction of medium quality of egyotian cottons into blends with MISR polyester fiber.

- At 50c/50p carded blends, the strength of G3i/PES blend yarnswere higher as compared to the corresponding 100% cotton. While the strengths for G70/PES are equal or slight lower than for the control yarns.

- Blends containing polyester ratios more 50% show a better blend yarns quality than for 100%cotton yarns.

- The blend yarn uniformity generally was better than for 100% cOtton yarns. This can be attributed to the uniformity of polyester staple fiber.

V) For the same cotton fiber, the results indicate that blends gave a better quality (strength and yarn uniformity) than for carded blends.

- The combing action for cotton fibers decreased the level of polyester content by 25% in combed blends than for carded blends to give the corresponding strength of 100% combed yarns.

- Since combing process improve the final quality and most of egyptian cottons has a superiour properties, the cotton fibers should be combed. On the other hand, medium cotton fibers with low grades used as carded for blending with MISR polyester fiber.

Aknowledgement:

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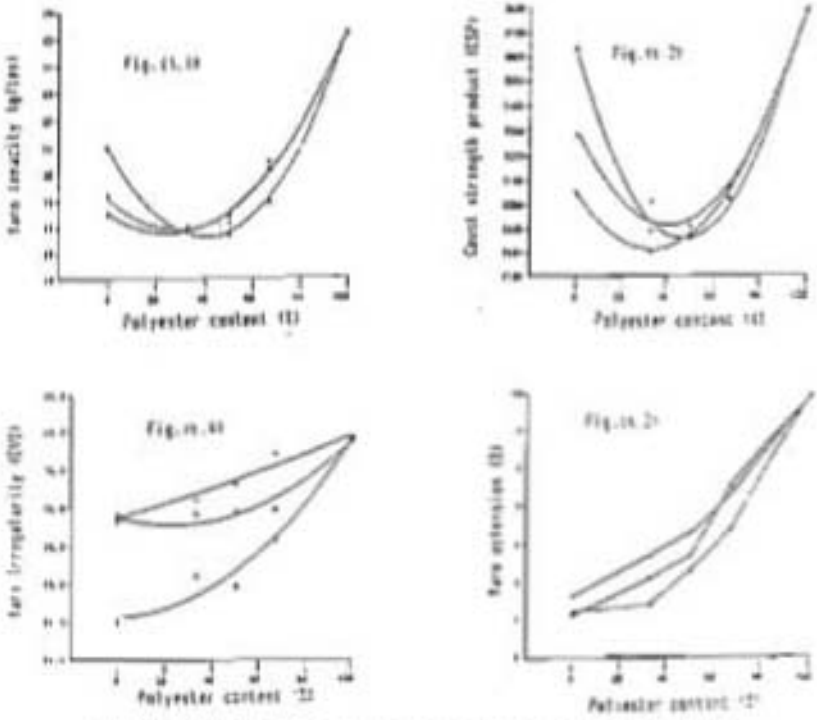


Fig.(1): Properties of 14.3 tex (Ne 40) combed cotton/polyester blended yarns.
(•) 520/PES, (▲) 675/PES, (■) 677/PES

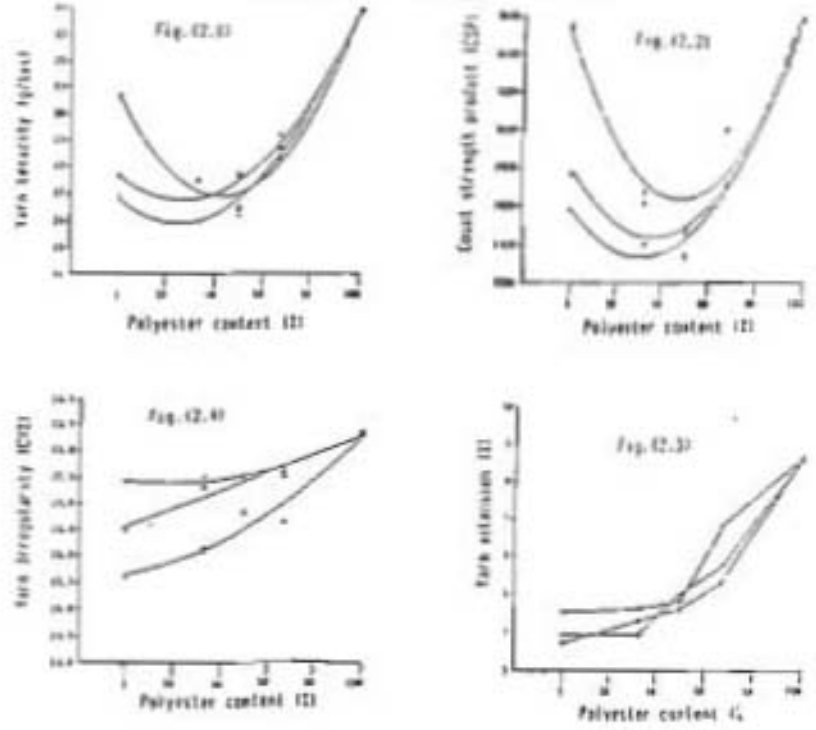


Fig.(2): Properties of 11.8 tex (Ne 50) combed cotton/polyester blended yarns.
(•) 670/PES, (▲) 675/PES, (■) 677/PES

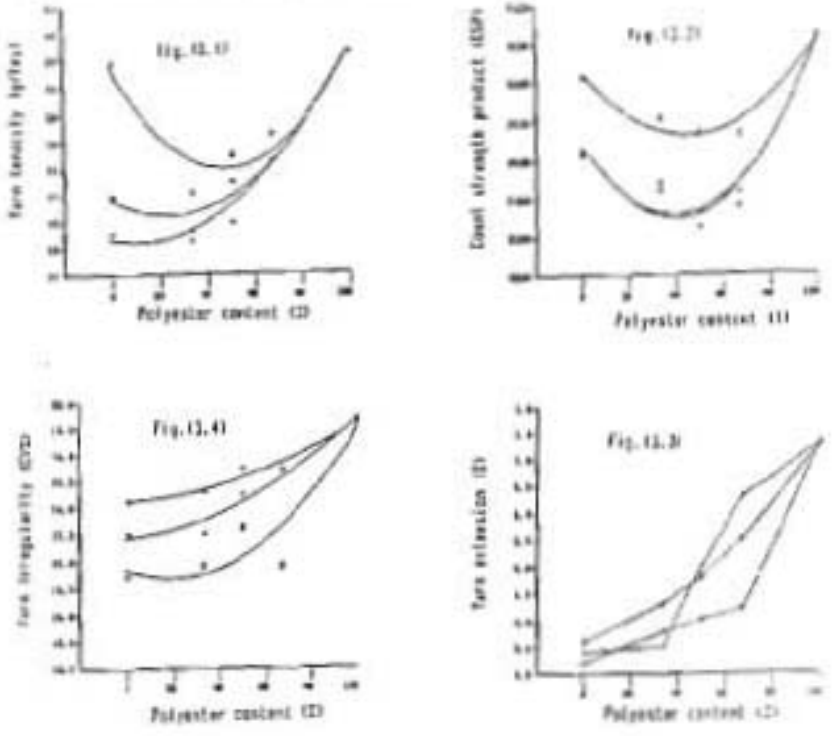


Fig.(3) Properties of 30 tex (Ne.20) combed cotton/polyester blended yarns.
(+) 67/33 PES, (□) 67/33 PES, (×) 67/33 PES

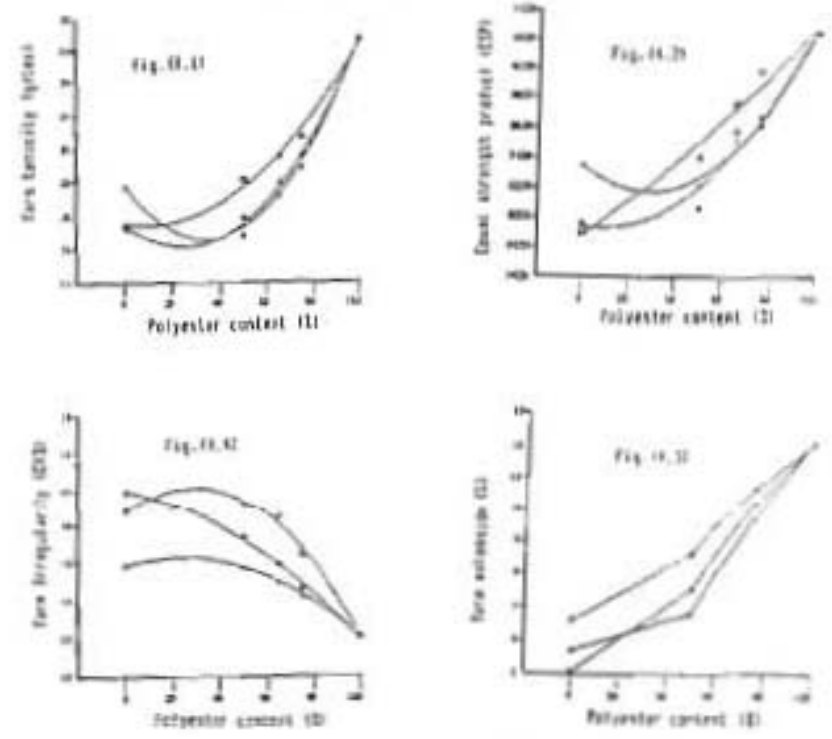
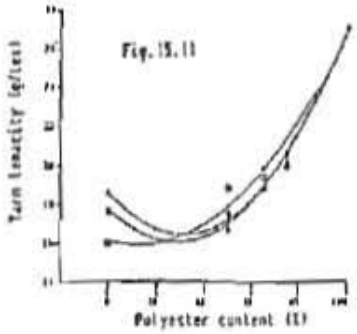
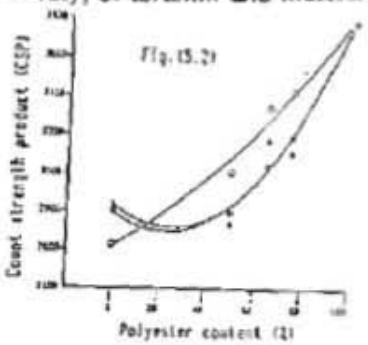
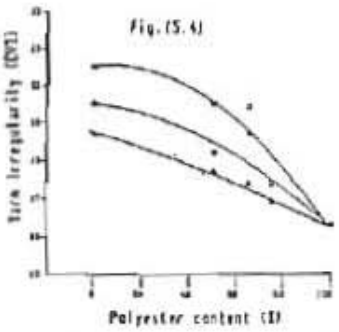


Fig.(4) Properties of 30 tex (Ne.20) carded cotton/Polyester blended yarns.
(+) 67/33 PES, (□) 67/33 PES, (×) 67/33 PES







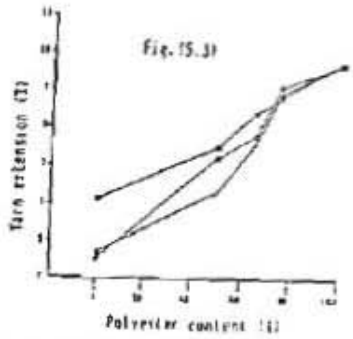
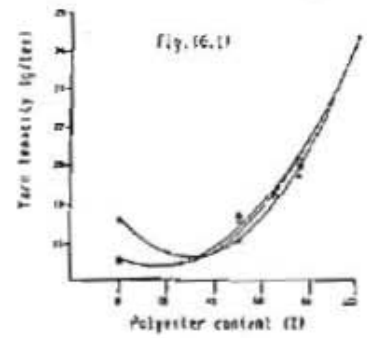
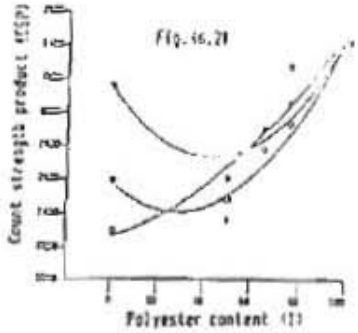
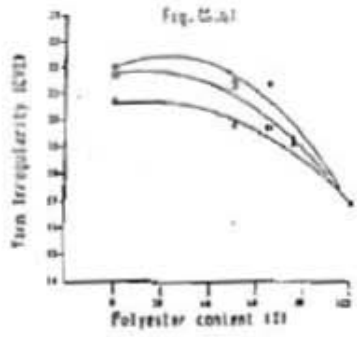


Fig. (5) Properties of 20 tex (Ne. 30) carded cotton/polyester blended yarns.
(a) 651/PES, (•) 970/PES, (▲) 635/PES







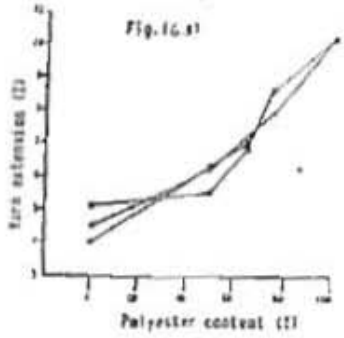


Fig. (6) Properties of 14.8 tex (Ne. 40) carded cotton/polyester blended yarns.
(a) 651/PES, (•) 970/PES, (▲) 635/PES

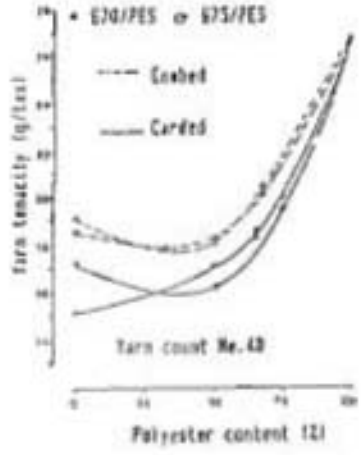


Fig.(7) Comparison of combed and carded blends

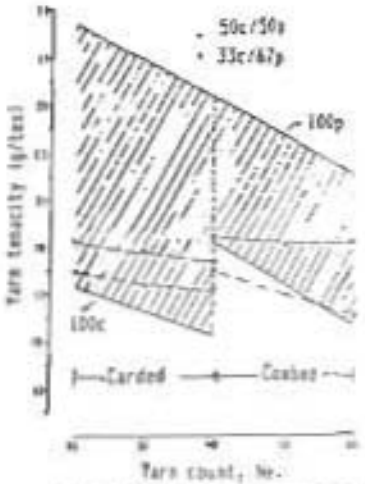


Fig.(8) Effect of processing and yarn counts on yarn strength for 67C/PES blends.

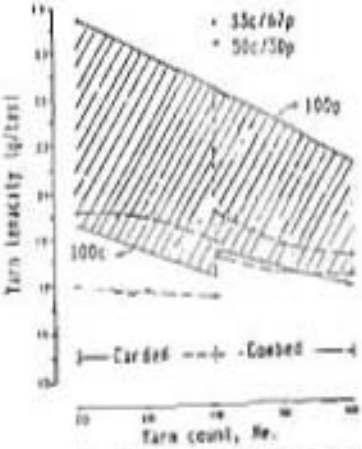


Fig.(9) Effect of processing and yarn counts on yarn strength for 67S/PES blends

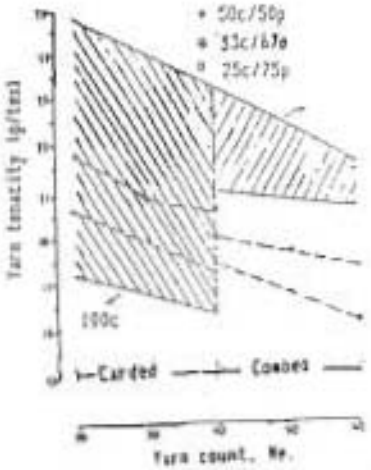


Fig.(10) Effect of processing and yarn counts on yarn strength for 33/PES blends.