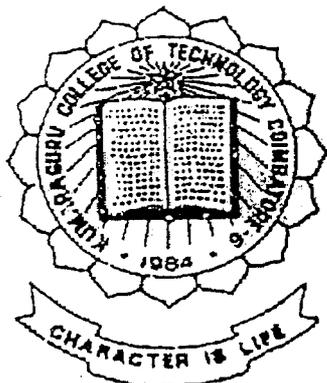


PERFORMANCE RATING OF JUCO ROTOR YARN

P-236



Project Report

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**BACHELOR OF TECHNOLOGY IN
TEXTILE TECHNOLOGY**
of the Bharathiar University

1999 - 2000

DEPARTMENT OF TEXTILE TECHNOLOGY
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Certificate

This is to certify that the project report entitled

PERFORMANCE RATING OF JUCO ROTOR YARN

has been submitted by

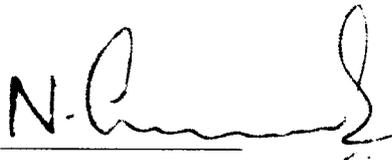
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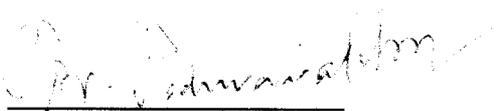
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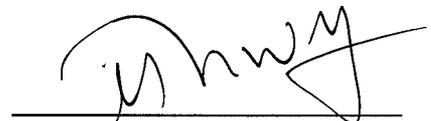
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ACKNOWLEDGEMENT

We express our gratitude and thanks to our principal Mr.K.K.Padmanabhan and Prof. A.R.Padmanabhan, Head of the Department of Textile Technology for their valuable suggestions.

We are greatly indebted to Mr.N.Gokarnesan, Lecturer, Department of Textile Technology for his valuable guidance, and personal supervision at all stages of this project work to complete it in a successful manner.

We also thank all the faculty members of the Department of Textile Technology for their kind co-operation and encouragement during the course of this work.

Finally we thank our student friends for their continued support and encouragement for carrying out this work in a successful manner.

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SYNOPSIS

To make use of jute/cotton yarns in household textiles these yarns are to be improved in terms of appearance and wear life (abrasion resistance)

In this project an attempt has been made to infer the suitability and performance of jute rotor yarn in household textiles. This is in view of the fact that twisting tension is less in rotor spinning, which results in yarns with better abrasion resistance, less harshness in relation to their ring counterparts.

The inference is confirmed in this project by producing jute/cotton yarn in rotor spinning machine in a blend ratio of 50:50. Then the yarn is woven into fabric.

A comparative study is done with fabrics made of jute yarn and other blends viz polyester/cotton, flax/cotton and 100% cotton, which reveals that the appearance and wear life (abrasion resistance) of jute yarn is improved in rotor spinning.

1. INTRODUCTION

The properties of a fabric are primarily dependent upon the type of material used besides the constructional parameters. Each type of fibre has different properties. The type of fibres used not only affects the yarn and fabric properties but also their performance in the respective machine i.e, spinning and weaving. In order to get certain desirable properties in the yarn and fabric, which may not be derived by using a single type of fibre, it becomes necessary to blend two or more different types of fibres to get the desired effect.

Another reason for blending two or more types of fibres is for economical reasons. Thus, the blending of two or more fibres can be purely for technical reason or an economical point of view or a combination of both.

With the population growth shooting high, the demand for cloth has taken gaint leaps; It has therefore become necessary to have multi fibre utilisation. So hence, this project has been undertaken with the following objectives.

- i) To optimize process parameters in rotor spinning to spin Jute/Cotton blends.
- ii) To make use of appropriate household and decorative textiles from jute fibres, using rotor spinning.

Thus, to make use of Jute fibres in household textiles and decorative fabrics.

The properties of Jute/Cotton fabric which is made out of Jute/Cotton O.E yarn has been compared with other blended fabrics to get a comparative idea of its practical utility.

2. REVIEW OF LITERATURE

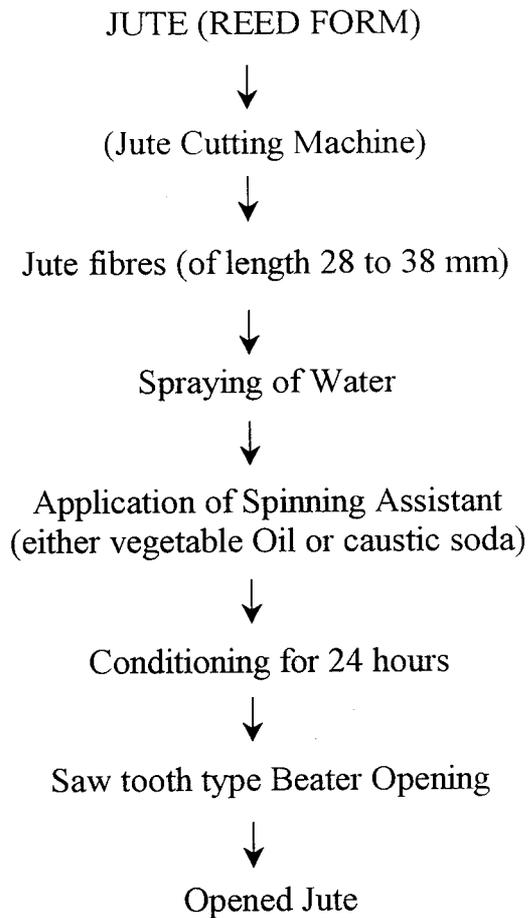
2.1 SCOPE AND APPROACH:

The need for various blends of fibres in various proportion is due to increase in consumption of yarn and also the necessity to bring down scarcity for anyone particular fibre and also to reduce the raw material cost. India has a strong base for jute and also is the largest producer in the world. The production is more than 70 million bales. The government of India and UNDP have both invested around 120 crores out of which \$23 million will come as UNDP assistance for developing jute industry and thus to promote the use of jute fibres. Hence in this project we have attempted to use jute fibres effectively by blending.

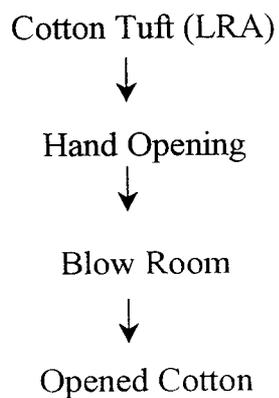
Jute and Cotton is blended in a ratio of 50:50 and then made into yarn using rotor spinning. The yarn thus formed posses good abrasion resistance, appearance and life which is normally not obtained with ring spinning. Thus, Jute/Cotton yarn is produced in the following sequence.

2.2. PROCESS SEQUENCE (JUTE/COTTON)

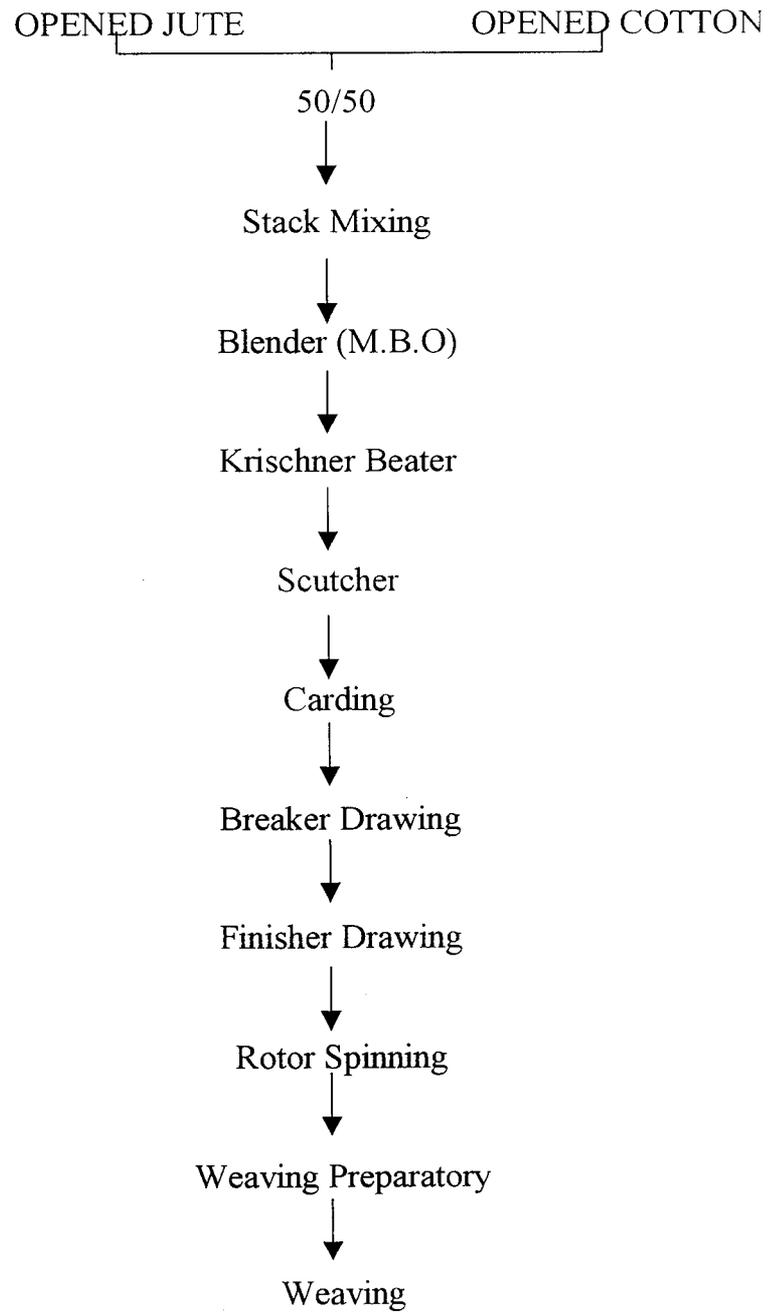
PREPARATION OF JUTE FIBRE



PREPARATION OF COTTON FIBRES



BLENDING AND O.E SPINNING



2.3 CONVERSION OF FIBRE TO YARN

In the production Jute / Cotton blended yarn, initially the jute and cotton fibres are individually prepared.

For jute fibre preparation, the raw material availability is in the form of jute reeds. The jute reed is fed into the jute cutting machine, and it is cut into the fibre length of 28 mm to 38 mm.

After cutting the jute fibres, the water is sprayed over it. After this some spinning assistants are applied over the opened jute fibres in order to improve the inter fibre cohesion and softness of jute fibres.

The spinning assistants may be caustic soda or vegetable oil. In caustic soda application it is known as woollenisation treatment.

Jute fibres were treated with 18% sodium hydroxide solution at room temperature, for 24 hours. (The concentration of alkali and the duration of treatment were optimized by varying the factors given below :

- i) The concentration between 12 and 18% and
- ii) The treatment time between 24 hours and 48 hours) to impart crimp and softness to the jute fibres.

Vegetable oil was used as the spinning assistant, which was sprayed over the opened jute fibres and it was conditioned for 24 hours.

Then the conditioned jute fibres were opened with saw tooth type beater. In preparation of cotton fibres, the LRA type of cotton is used. The cotton tufts were initially hand opened and fed to the blow room line and it is opened. Then the cotton fibres were blend with jute.

The opened jute and opened cotton fibres are blended in the proportion of 50 : 50.

Then stack mixing was prepared for juco blend and fed to the blow room line. Then the stack mixing was processed by employing mixing bale Opener and Krischner beater and was taken in a lapform in the scutcher unit.

The lap was fed to the carding machine and we have taken the carded sliver of hank 0.10, with the Doffer speed of 10 rpm. The carded sliver was subjected to two passages of drawing.

- i). Breaker Drawing
- ii) Finisher Drawing

For this purpose a drawframe of type LR DO/2S was used.

After drawframe passage, we have taken out the drawn sliver of hank 0.12 with the delivery speed of 100m/min.

The drawn sliver was fed to the rotor spinning machine M1/2 and the Juco O.E yarn was produced. During the yarn production, the following parameters were maintained.

- ◆ Rotor speed - 40000 rpm
- ◆ Opening roller speed - 6000 rpm
- ◆ Rotor dia – 64 mm.
- ◆ Separator angle – 90°.

After weaving preparatory processes such as warping and sizing, the fabric was woven.

2.4 ROTOR SPINNING TRAIL STUDY

In rotor spinning trails we have also conducted a study of following aspects.

- i) Effect of rotor speed on yarn quality.
- ii) Effect of twist on yarn quality.

2.4.1 EFFECT OF ROTOR SPEED ON YARN QUALITY

Draw frame sliver made out of 50/50 Jute/Cotton blend were spun on M1/2 open end spinning machine at three different rotor speeds.

The yarn quality parameters are given in table. 1.

TABLE : 1
YARN QUALITY AT DIFFERENT ROTOR SPEEDS

OPENING ROLLER SPEED : 6000 rpm T.M = 5.8			
COUNT OF YARN : 10 ^s			
ROTOR SPEEDS	A	B	C
Yarn Quality			
i. RKM (g/tex)	6.42	8.28	9.18
ii. Breaking elongation(%)	6.27	4.51	3.88

A - Rotor speed of 36,000 rpm

B - Rotor speed of 40,000 rpm

C - Rotor speed of 45,000 rpm

It is quite clear that within the range of speeds covered in this study, the yarn strength improves with rotor speed. For every 1% increase in rotor speed, the strength of jute cotton blended yarn improves by 1.7% in the case of 10^s count. However the elongation decreases about 2.39% in the case of 10^s count. When the rotor speed is increased from 36000 rpm to 45000 rpm, an increase in rotor speed increases the centrifugal force acting on the yarn tail is given by

$$\text{Centrifugal force (g/tex)} = \frac{W^2 \times 0.981}{20,000}$$

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Where

$$W = \pi \times DN$$

D – Rotor dia in cm and

N – Rotor speed in rps.



Because of this higher centrifugal force better consolidation of fibres could be expected which in turn will lead to higher strength. But, increase in speed also has some detrimental influence towards strength.

2.4.2 EFFECT OF TWIST LEVEL ON YARN QUALITY

The quality of 10^s yarn spun using 50/50 blend of Jute Cotton in rotor spinning machine is given in Table 2.

TABLE : 2
QUALITY OF ROTOR SPUN YARN AT DIFFERENT TWIST
LEVELS

(Rotor Speed – 36000 rpm, Opening Roller Speed – 6000 rpm)			
Count of Yarn : 10 ^s			
T.M Level	5.0	5.4	5.8
Yarn Quality			
i.RKM (g/tex)	5.55	5.72	6.42
ii.Mean Elongation (%)	6.06	6.21	6.43

For different twist levels, strength increases with twist on an average. For unit increase in twist, tenacity improves by about 20% in the case of 10^s count Thus, the yarn with 50% jute and 50% cotton was produced in open end spinning machine.

2.5 CONVERSION OF YARN TO FABRIC

The yarn obtained from the rotor spinning was then taken to the loom and then woven into a cloth with following parameters.

Ends per inch	-	38
Picks per inch	-	30
Cover factor		
Warp	-	12.02
Weft	-	9.49
Cloth cover factor	-	16.76
Type of weave	-	Plain Weave (1/1)

LOOM AND ITS SPECIFICATION

TYPE OF LOOM	-	Hand Loom
LOOM WIDTH	-	63"
SHEDDING MOTION	-	Plain Weave (1/1)

2.6 PRODUCTION OF FABRIC WITH OTHER BLENDS

Other blends like polyester cotton, flax cotton and 100% cotton yarns (10^s count) which were purchased from various sources were woven into fabrics with the below given cloth parameters in order to make comparative comprehensive study.

Ends per inch - 38

Picks per inch - 30

Cover factor

Warp - 12.02

Weft - 9.49

Cloth cover factor - 16.76

Type of weave - PlainWeave(1/1)

warp yarn count - 10^8

Weft yarn count - 10^8

3. METHODOLOGY

The method followed to assess the performance rating of Juco open end spinning yarn was done using three stages as follows:

- Juco O.E yarn formation.
- Juco (O.E yarn) fabric formation.
- Comparative study with fabric of other blends.

3.1 JUCO O.E YARN FORMATION

The jute fibres and cotton fibres were processed individually and then blended at the blow room stage and was furtherly processed. After getting the second passage of draw frame sliver, was passed through rotor spinning and the influence of various factors over the yarn quality was studied by varying the speed and twist , and the yarn was produced with the blend ratio of 50 : 50 and the count of the yarn is 10^s.

3.2 FABRIC FORMATION (JUCO)

The rotor jute yarn is woven into a fabric using a Bit loom which is 63” wide. The fabric is made with the following parameters.

Ends per inch	-	38
Picks per inch	-	30
Cover factor		
Warp	-	12.02
Weft	-	9.49
Cloth cover factor	-	16.76
Type of weave	-	Plain Weave (1/1)
Warp yarn count	-	10 ^s
Weft yarn count	-	10 ^s

3.3 COMPARATIVE STUDY WITH FABRIC OF OTHER BLENDS

Comparative study with fabric of other blends is done in 2 ways.

- i. Formation of fabric of other blends
 - ii. Assessment through comparison.
- i. The fabric is formed using other blends like polyester/cotton, viscose/cotton, with the following constructional detail.

Ends per inch	-	38
Picks per inch	-	30
Cover factor		
Warp	-	12.02
Weft	-	9.49
Cloth cover factor	-	16.76
Type of weave	-	Plain Weave (1/1)
Warp yarn count	-	10 ^s
Weft yarn count	-	10 ^s

3.4 ASSESSMENT THROUGH COMPARISION

The exact performance rating of Juco rotor yarn fabric is assessed by making a comprehensive comparative study with the fabric of other blends like P/c, F/c and 100% cotton in the following respects.

3.5 NAME OF THE TESTS

- i) Abrasion Resistance
- ii) Bursting strength
- iii) Crease recovery
- iv) Bending length
- v) Tensile strength
- vi) Colour fastness to washing
- vii) Colour fastness to rubbing
- viii) Colour fastness to perspiration.

4. RESULTS AND DISCUSSION

Based on the various tests that were carried out, the results are presented as given below:

4.1 RESULTS

TABLE :3

ABRASION RESISTANCE TEST FOR JUCO FABRIC

(LOSS IN WEIGHT%)

(50 CYCLES)

Sl.No.	Initial Weight	Final Weight	Loss in Weight %
1	0.255	0.247	3.137
2	0.261	0.254	2.682
3	0.249	0.234	6.024
4	0.251	0.236	5.976
5	0.252	0.237	5.952
6	0.249	0.234	6.024
7	0.255	0.248	2.745
8	0.260	0.252	3.077
9	0.251	0.236	5.976
10	0.250	0.242	3.2

Mean = 4.5%

TABLE :4

BURSTING STRENGTH OF JUCO FABRIC

Sl.No.	Bursting Strength (Lb/inch ²)
1	90
2	90
3	95
4	90
5	85
6	90
7	95
8	90
9	85
10	90
Mean	90

TABLE :5

BREAKING LOAD OF JUCO FABRIC

Sl.No.	Tensile Strength	
	Warp Way (Kg)	Weft Way
1	25.6	21.3
2	26.2	23.2
3	23.7	22.2
4	24.3	20.6
5	26.7	20.2
Mean	25.3	21.7

Testing Conditions:

Width of the ravelled strip = 50 mm

Gauge Length = 200 mm

TABLE :6**BENDING LENGTH OF JUCO FABRIC**

Sl.No.	Warp Way		Weft Way	
	Face (cm)	Back (cm)	Face (cm)	Back (cm)
1	2.8	2.9	3.6	3.4
2	3.0	3.1	3.3	3.6
3	2.8	2.7	3.0	3.2
4	2.5	2.5	3.0	3.6
5	2.7	2.8	3.3	3.2
6	3.0	3.0	3.0	3.0
7	2.7	2.6	3.4	3.4
8	2.8	2.5	3.6	3.0
9	2.5	2.7	3.5	3.2
10	2.8	2.7	3.2	3.0
Mean	2.775 cm		Mean	3.275 cm

TABLE :7**CREASE RECOVERY OF JUCO FABRIC**

Sl.No.	Warp Way	Weft Way
1	52°	45°
2	56°	48°
3	54°	52°
4	54°	45°
5	52°	49°
6	56°	52°
7	53°	45°
8	55°	48°
9	54°	46°
10	54°	52°
Mean	54°	48.2°

TABLE :8

CHEMICAL PROPERTIES OF JUCO FABRIC

COLOUR FASTNESS TO WASHING

Sl.No.	Change in Colour	Staining Cotton	Staining On Wool
1	3-4	5	5
2	3-4	5	5
3	3-4	5	5
4	3-4	5	5
5	3-4	5	5
Mean	3-4	5	5

Testing Conditions:

Temperature - 40 ° C

Grey scale rating

TABLE: 9

COLOUR FASTNESS TO PERSPIRATION

- GREY SCALE RATING

Sl.No.	Change in Colour		Staining on Cotton		Staining on wool	
	Alkaline	Acid	Alkaline	Acid	Alkaline	Acid
1	4	4	4 - 5	4 - 5	4 - 5	4 - 5
2	4	4	4 - 5	4 - 5	4 - 5	4 - 5
3	4	4	4 - 5	4 - 5	4 - 5	4 - 5
4	4	4	4 - 5	4 - 5	4 - 5	4 - 5
5	4	4	4 - 5	4 - 5	4 - 5	4 - 5

TABLE :10

COLOUR FASTNESS TO RUBBING

- **Stain On Cotton**
- **Grey Scale Rating**

Sl.No.	DRY	WET
1	4 - 5	4 - 5
2	4 - 5	4 - 5
3	4 - 5	4 - 5
4	4 - 5	4 - 5
5	4 - 5	4 - 5
Mean	4 - 5	4 - 5

TABLE :11**JUTE/COTTON FABRIC PROPERTIES**

Sl.No.	Mechanical Properties	Jute/Cotton
1	Bursting Strength (lb / inch²)	90
2	Abrasion Resistance (50 cycles) (Loss in Weight %)	4.5
3	Crease Recovery i.Warp way (Degrees) ii. Weft way (Degrees)	54 48.2
4	Bending Length (cm) i.Warp Way ii.Weft Way	2.775 3.275
5	Breaking load of Fabric Tensile strength (Width of ravelled strip-50mm, Gauge length-200mm) Warp way. Weft way	 25.3 21.7

TABLE : 12**JUTE / COTTON FABRIC PROPERTIES**

Sl.No.	Chemical Properties	Jute / Cotton
1	Colour Fastness to Washing at 40°C (Grey Scale Rating) Colour Change Staining on Cotton Staining on Wool	 3 – 4 5 5
2	Colour Fastness to Rubbing (Staining on Cotton) (Grey Scale Rating) Dry Wet	 4 – 5 4 – 5
3	Colour Fastness to Perspiration (Grey Scale Rating) For Alkaline Change in colour Staining on Cotton Staining on Wool For Acid Change in colour Staining on Cotton Staining on Wool	 4 4-5 4-5 4 4-5 4-5

TABLE : 13

**MECHANICAL PROPERTIES OF FLAX COTTON,
POLYESTER COTTON AND 100% COTTON FABRIC
ABRASION RESISTANCE (LOSS IN WEIGHT %)**

Sl.No.	No.of cycles	Type of Blend		
		P/C	F/C	100% C
1	50	1.76	4.5	4.52
2	50	1.72	3.53	4.0
3	50	1.80	3.79	4.3
4	50	1.73	3.47	4.2
5	50	1.71	4.43	4.42
6	50	1.82	3.98	4.0
7	50	1.83	4.72	3.9
8	50	1.68	3.63	4.2
9	50	1.71	3.97	4.4
10	50	1.64	4.63	3.9
Mean		1.74	4.117	4.155

TABLE :14**BURSTING STRENGTH (lbs / inch²)**

Sl.No.	F/C (Flax/Cotton)	100% Cotton	(Polyeste r/ Cotton)
1	125	160	200
2	130	170	210
3	130	170	210
4	125	165	205
5	120	160	200
6	125	165	200
7	120	160	210
8	125	170	205
9	120	165	210
10	130	165	200
Mean	125	165	205

TABLE : 15**BREAKING LOAD OF DIFFERENT BLENDED FABRICS****TENSILE STRENGTH (Kg)**

Sl.N o.	P/C		F/C		100% C	
	Warp Way (Kg)	Weft Way (Kg)	Warp Way (Kg)	Weft Way (Kg)	Warp Way (Kg)	Weft Way (Kg)
1	64.3	64.2	30.0	32.4	26.4	25.4
2	63.8	64.0	31.0	33.0	26.5	24.4
3	64.4	63.8	30.8	33.1	26.7	25.6
4	64.1	63.7	30.5	32.3	26.5	25.6
5	63.7	64.1	30.2	32.7	25.9	24.9
Mea n	64.1	64.0	30.5	32.7	26.5	25.4

- Strip ravell method
- Width of ravelled strip - 50mm
- Gauge length - 200mm

TABLE : 16.1**BENDING LENGTH OF DIFFERENT BLENDS****WARP WAY READINGS**

Sl.N o.	P/C		F/C		100% C	
	Face (cm)	Back (cm)	Face (cm)	Back (cm)	Face (cm)	Back (cm)
1	2.9	2.8	2.8	2.7	3.2	2.9
2	3.2	2.9	3.0	3.1	2.9	2.9
3	2.8	3.1	3.1	2.9	2.9	3.2
4	2.9	3.0	2.8	3.0	3.0	3.0
5	2.8	2.7	2.7	2.8	3.2	2.8
6	3.1	3.1	2.9	2.8	3.1	3.1
7	3.0	2.7	3.2	2.9	2.8	3.1
8	2.8	2.6	2.7	3.0	3.2	2.8
9	2.9	2.6	2.9	2.7	2.8	3.2
10	2.8	2.7	3.1	2.7	2.9	2.7
	Mean	2.96	Mean	2.9	Mean	3.0

TABLE : 16.2**BENDING LENGTH OF DIFFERENT BLENDS****WEFT WAY**

Sl.N o.	P/C		F/C		100% C	
	Face (cm)	Back (cm)	Face (cm)	Back (cm)	Face (cm)	Back (cm)
1	3.1	3.0	2.8	3.1	2.3	2.2
2	3.0	3.1	3.2	2.8	2.5	2.4
3	3.2	2.9	3.0	2.7	2.4	2.6
4	2.8	3.2	3.1	3.2	2.4	2.5
5	3.1	2.8	2.7	3.0	2.1	2.5
6	3.2	2.9	2.9	2.9	2.6	2.0
7	3.0	3.2	3.3	3.2	2.3	2.3
8	2.8	2.8	3.0	3.1	2.6	2.3
9	2.9	2.7	2.7	2.8	2.4	2.2
10	3.1	3.2	3.3	3.2	2.4	2.4
	Mean	3.0375	Mean	3.00	Mean	2.4

TABLE : 17

CREASE RECOVERY OF DIFFERENT BLENDS

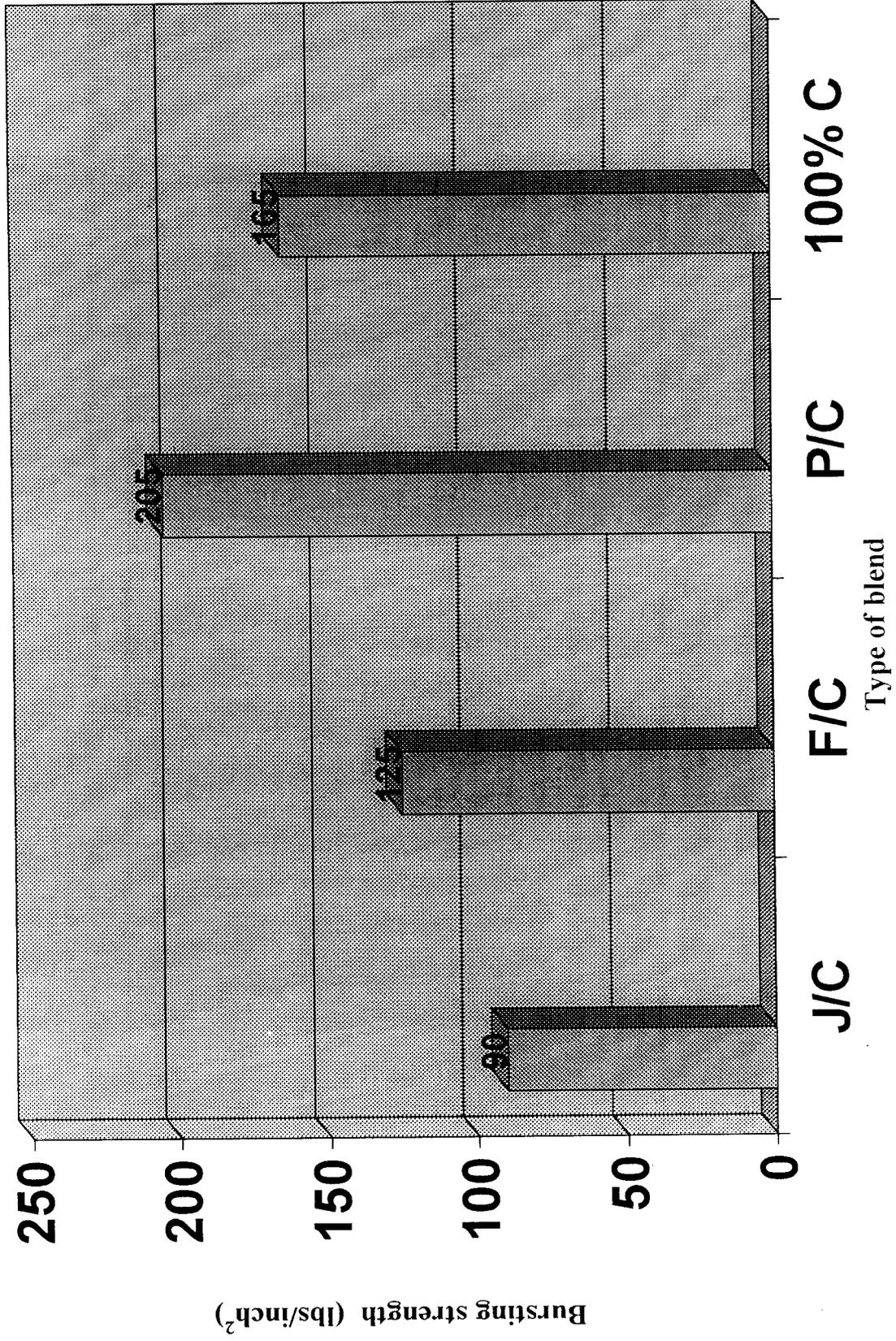
Sl.No	P/C		100 % C		F/C	
	Warp Way	Weft Way	Warp Way	Weft Way	Warp Way	Weft Way
1	74°	70°	65°	56°	53°	54°
2	76°	70°	64°	57°	54°	56°
3	70°	72°	65°	56°	52°	52°
4	74°	68°	66°	56°	53°	54°
5	73°	71°	63°	56°	53°	55°
6	75°	69°	64°	57°	54°	54°
7	70°	72°	64°	54°	52°	53°
8	74°	69°	63°	56°	51°	52°
9	73°	70°	66°	59°	55°	56°
10	73°	72°	66°	54°	53°	54°
Mean	73.3°	70.66°	64.66°	56.5°	53°	54°

TABLE : 18

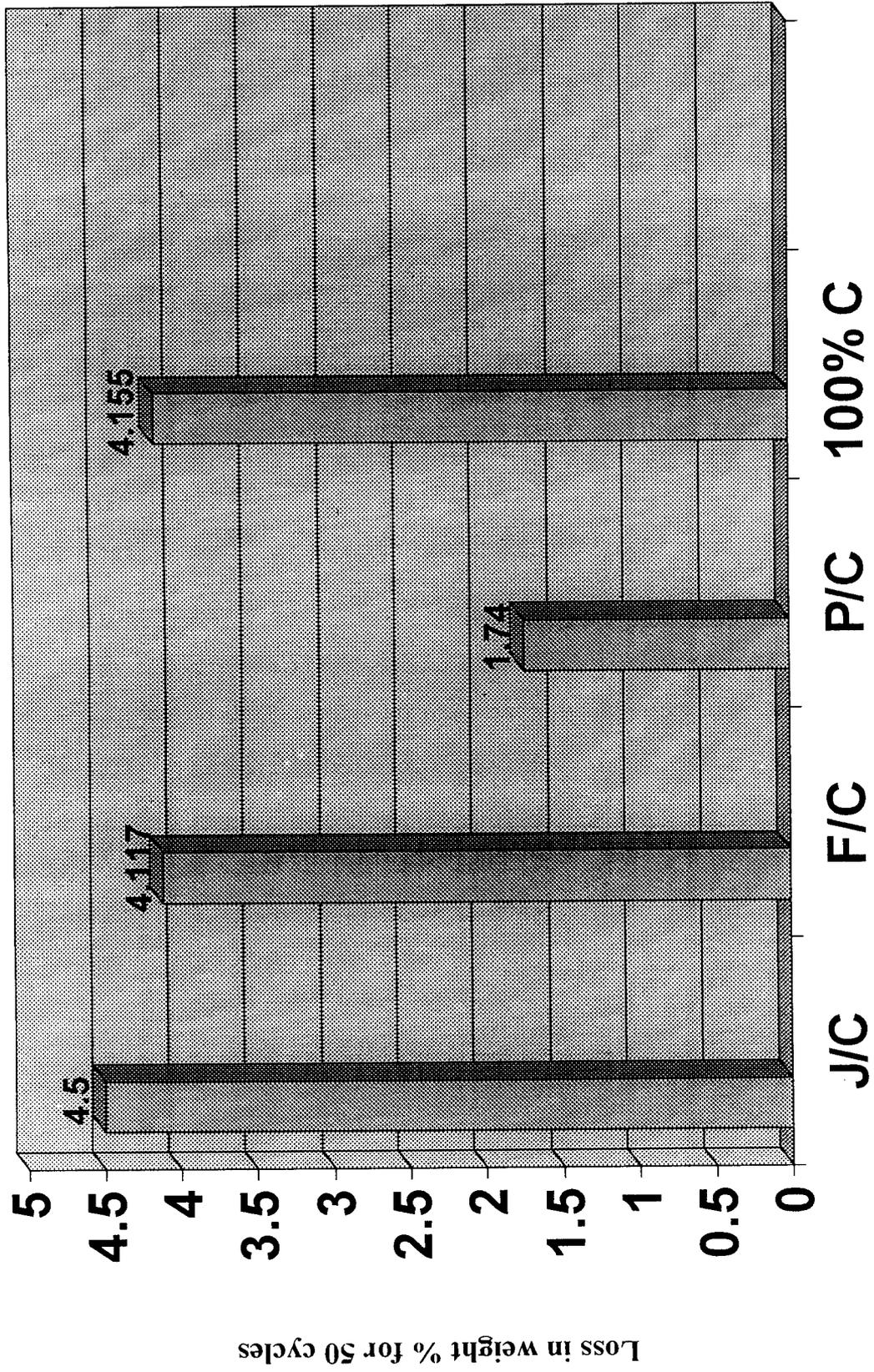
**MECHANICAL PROPERTIES COMPARISON OF
DIFFERENT BLENDS**

Sl.No	PROPERTY	TYPE OF BLENDS			
		Jute / Cotton	Flax / Cotton	Poyester / Cotton	100% Cotton
1	Bursting Strength (lb/inch ²)	90	125	205	165
2	Abrasion Resistance (50 Cycles) (loss in Weight %)	4.5	4.117	1.74	4.15
3	Crease Recovery i. Warp Way (Degrees) ii. Weft Way (Degrees)	54 48.2	53.00 54.00	73.33 70.66	64.66 56.5
4	Bending Length (cm) i. Warp Way ii. Weft Way	2.775 3.275	2.9 3.0	2.96 3.0375	3.00 2.4
5	Breaking load fabric Tensile strength (width of raveled strip – 50mm) Gauge length – 200mm Warp way Weft way	25.3 21.7	30.5 32.7	64.1 64.0	26.4 25.4

GRAPH : 1
BURSTING STRENGTH

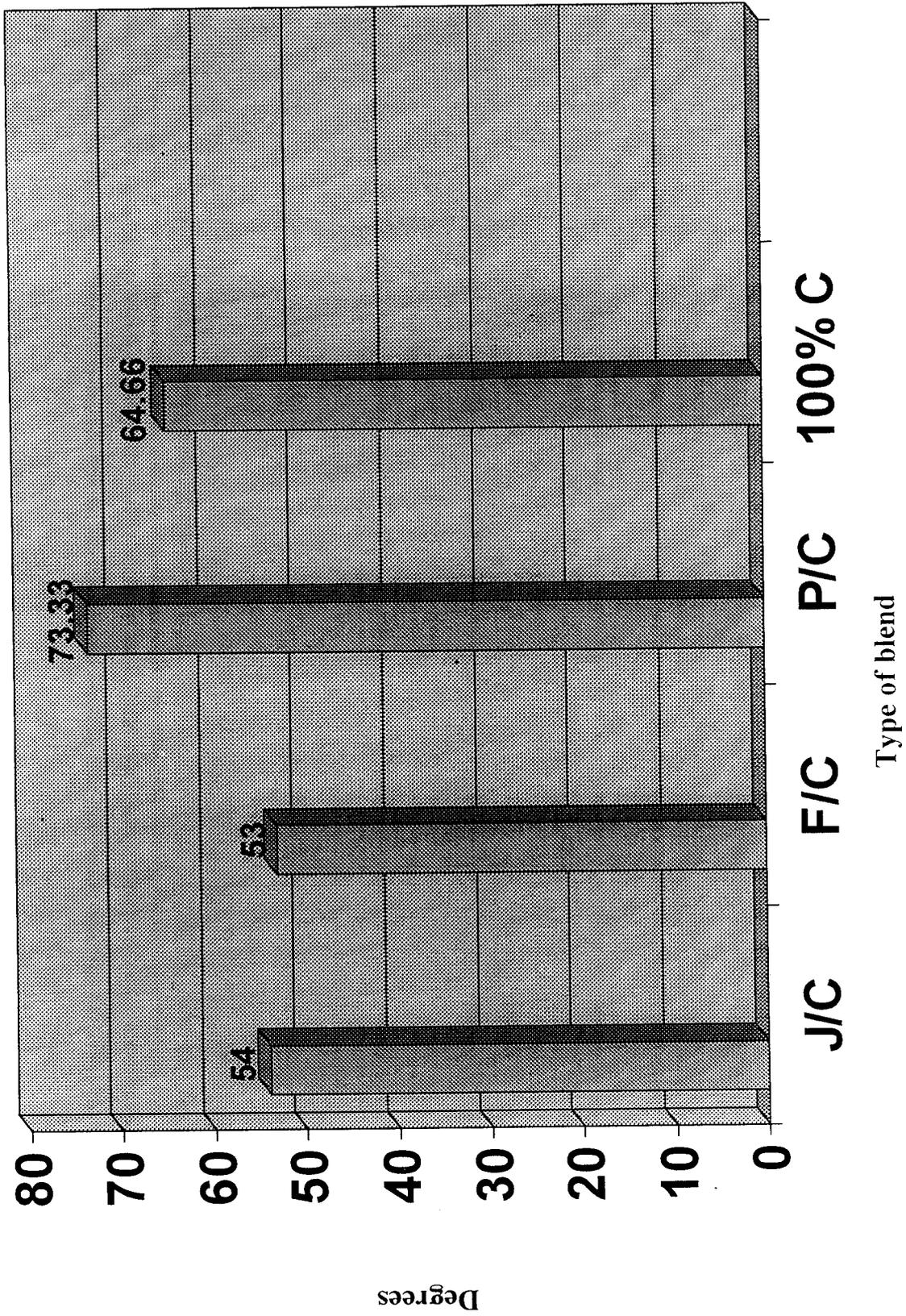


GRAPH : 2
ABRASON RESISTANCE

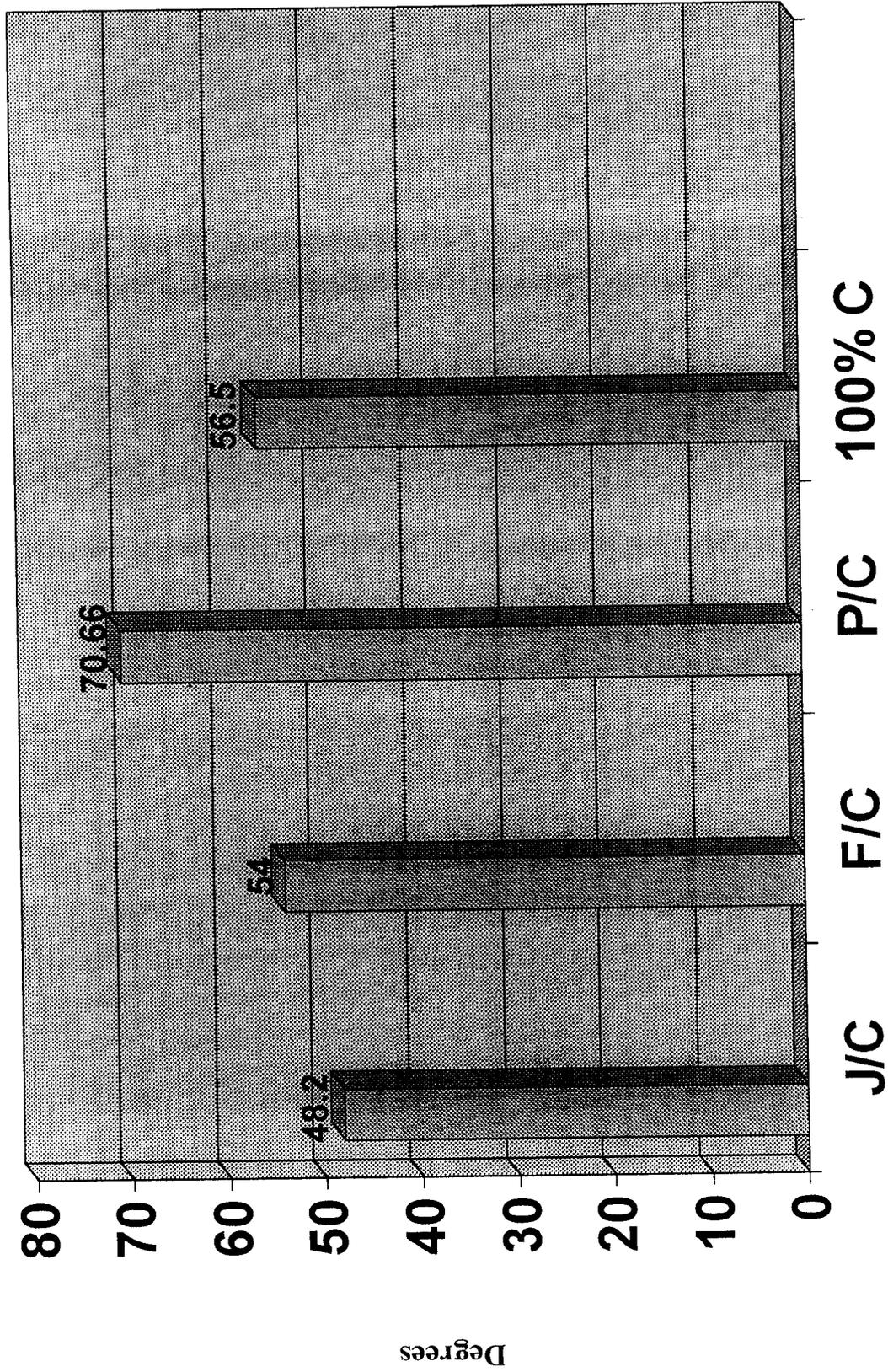


Type of blend

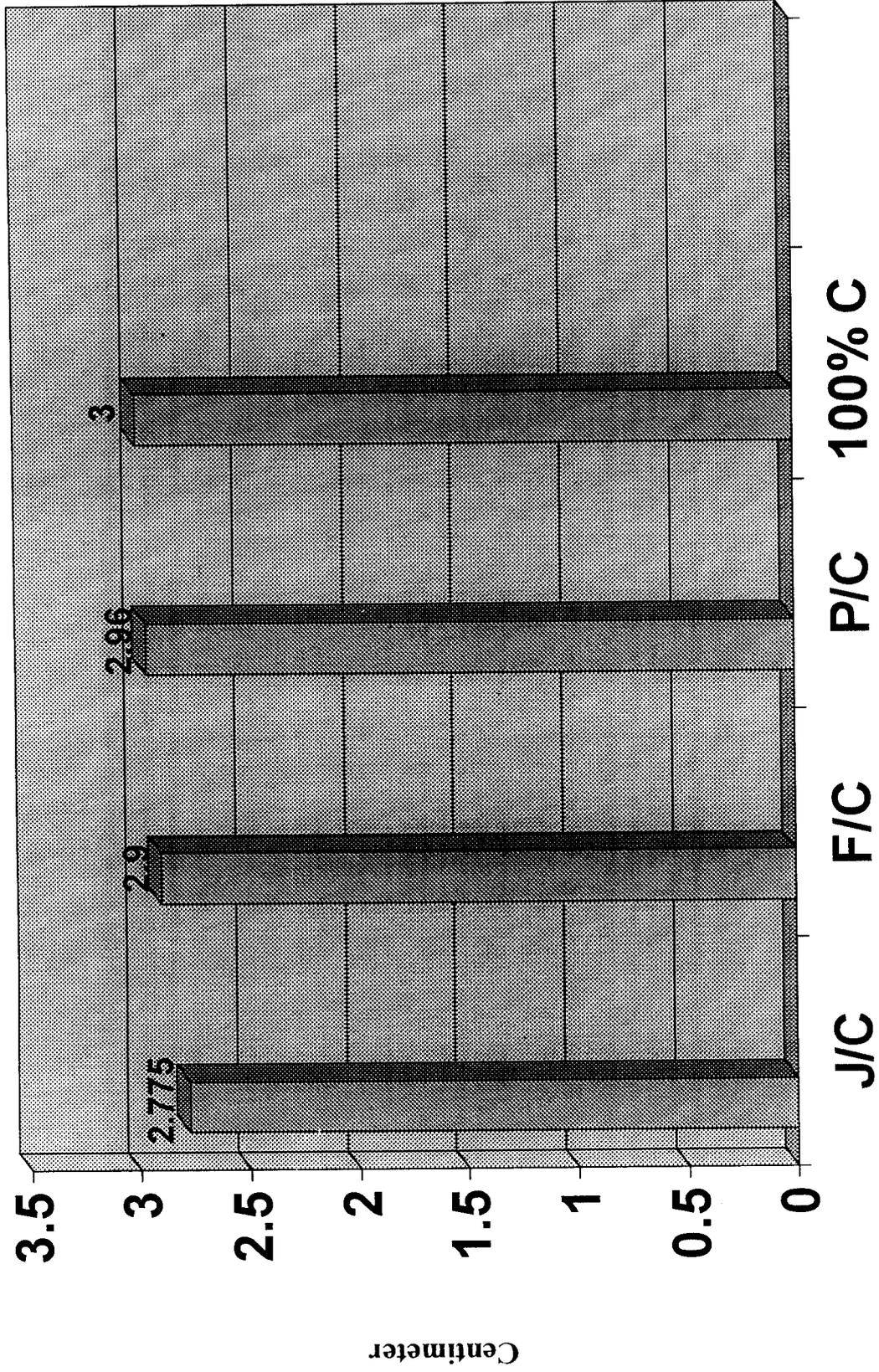
GRAPH : 3
CREASE RECOVERY (WARP WAY)



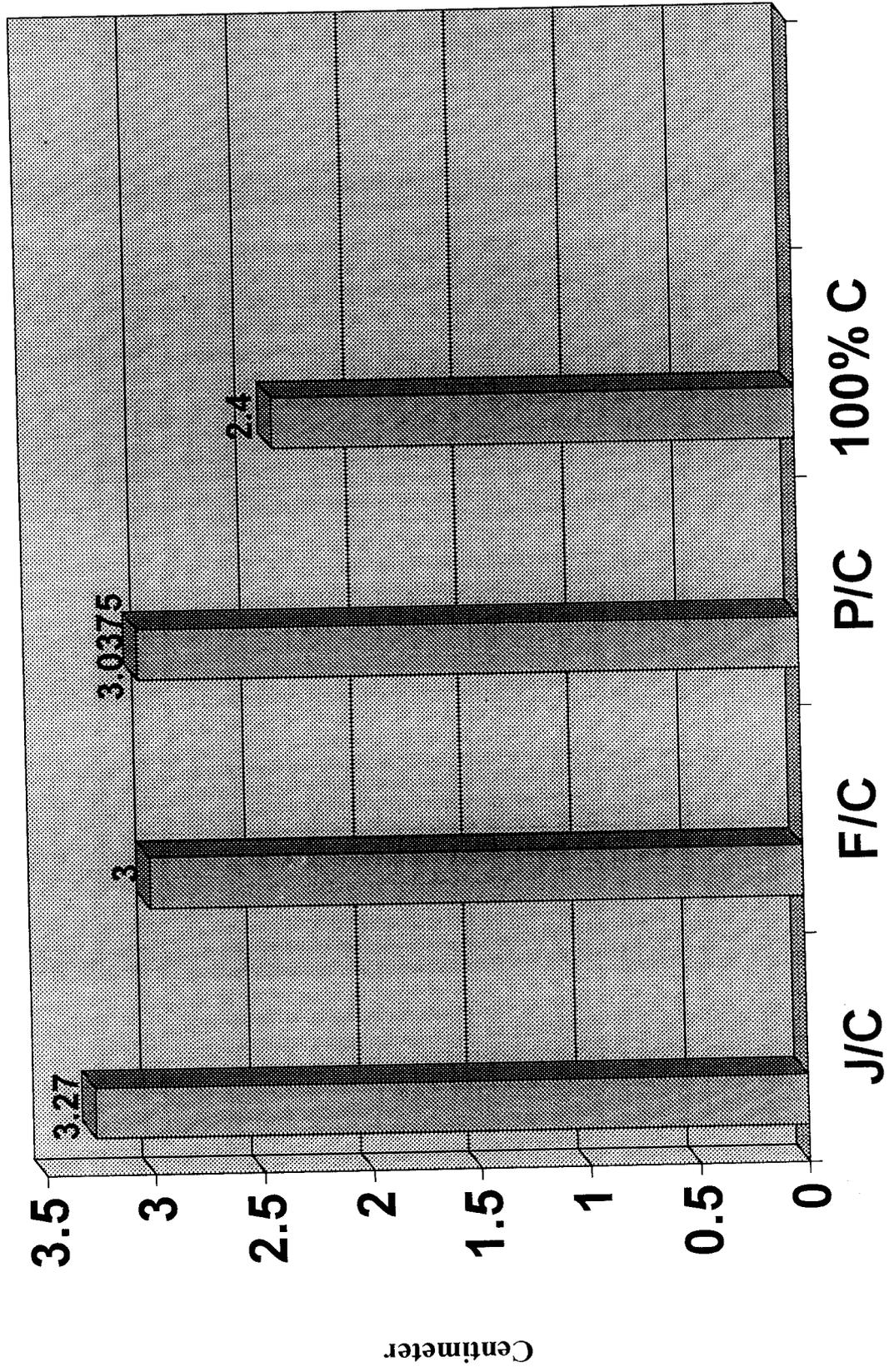
GRAPH : 4
CREASE RECOVERY (WEFT WAY)



GRAPH : 5
BENDING LENGTH (WARP WAY)

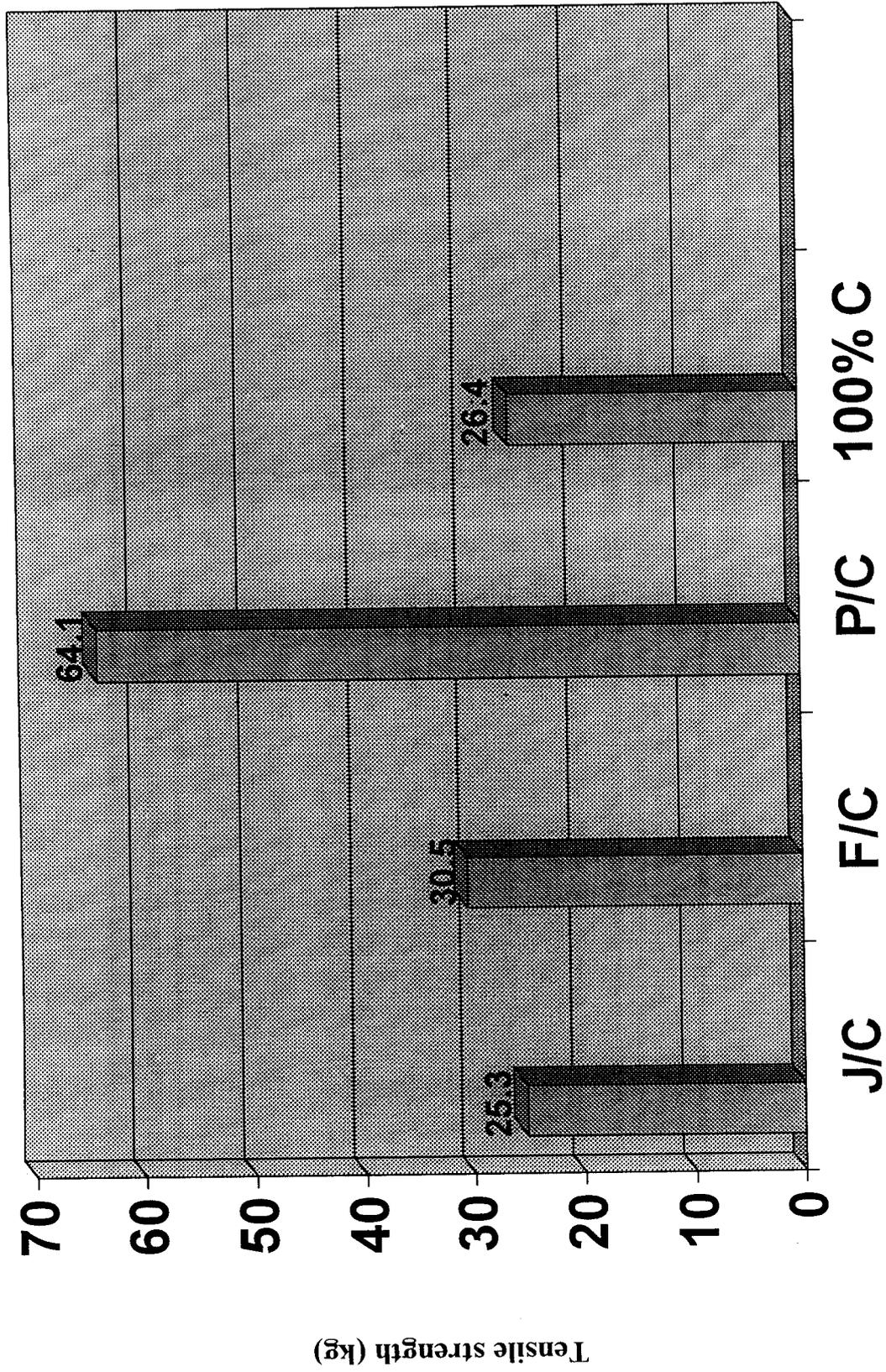


GRAPH : 6
BENDING LENGTH (WEFT WAY)



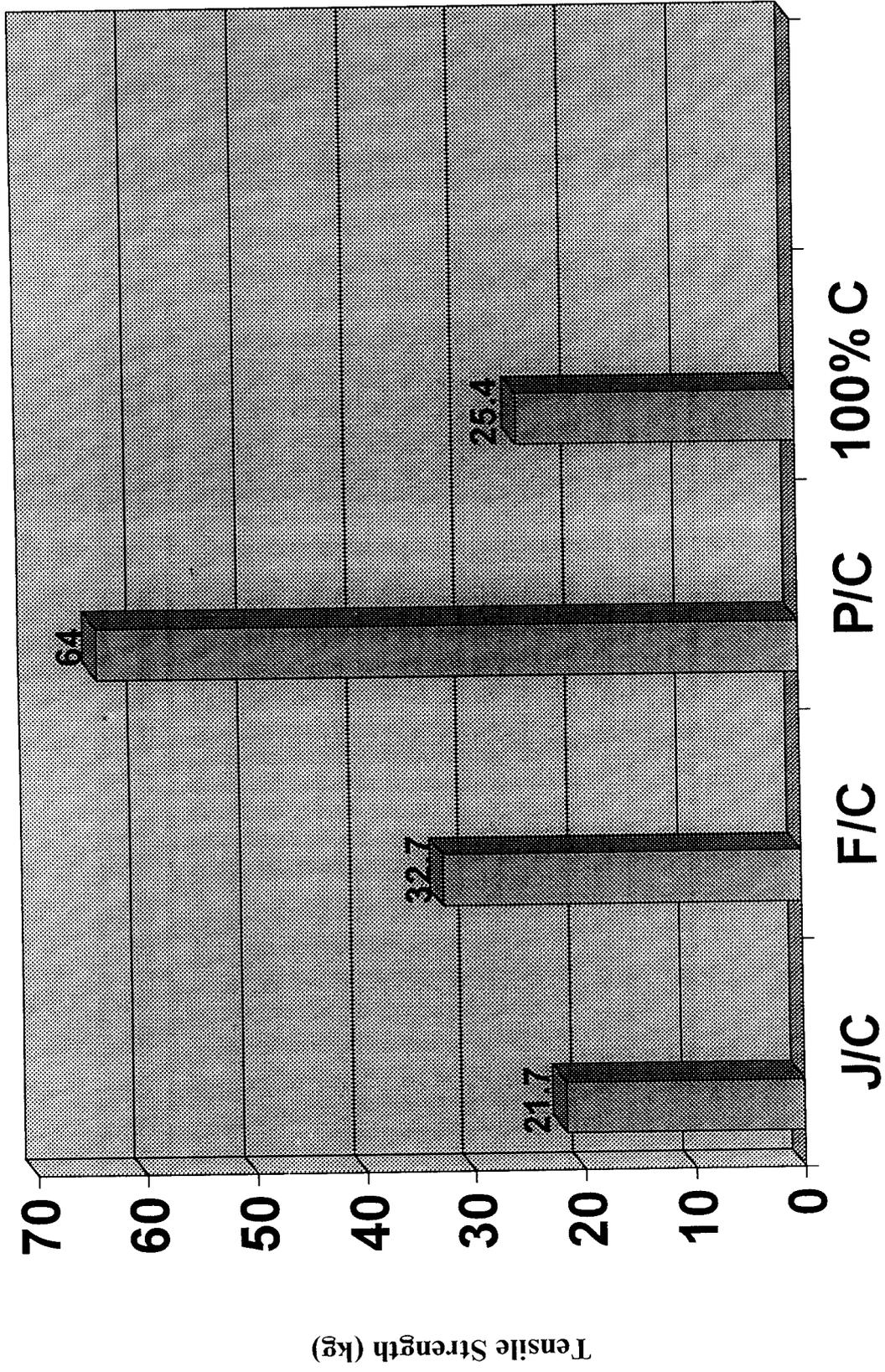
Type of blend

GRAPH : 7
BREAKING LOAD OF FABRIC (WARP WAY)



Type of blend

GRAPH : 8
BREAKING LOAD OF FRABRIC (WEFT WAY)



Type of blend

4.2 DISCUSSION

1. Bursting strength

Out of the various samples tested P/C cloth had the highest bursting strength, while juco cloth had the lowest value seen in the (Graph1).

2. Abrasion Resistance

Jute/Cotton cloth had the highest value of abrasion resistance while polyester / cotton cloth had the lowest value. (Graph 2)

3. Crease recovery

The value of crease recovery angle was found to be more in warp way than in weft way. In both cases P/C cloth showed maximum value and Juco showed the lowest value(Graph 3 & 4).

4. Bending length

The value of bending length was found to be maximum in warp way in case of 100% cotton cloth and minimum in case of Juco cloth. In the weft way Juco had the highest value and cotton had the lowest value(Graph 5 & 6).

5. Breaking load

P/C cloth gave the highest value both in warp and weft way, while Juco cloth showed the lowest value(Graph 7 & 8).

Chemical Tests

- Juco showed moderate fastness to wash.
- The fastness to perspiration was rated good.
- Colour fastness to rubbing also rated good.

5. CONCLUSION

From the results it is evident that Juco had the highest value of abrasion resistance . this was due to the contribution of the jute components (Jute being a coarse fibre).

Crease recover for P/C was highest. This is attributable to the flexibility of the polyester component in the blend.

Juco cloth showed the lowest value of breaking load. This was due to the poor strength of the jute component.

As per the chemical tests, the juco cloth had a moderate value of wash fastness. Hence the cloth which was dyed can not be used in fabrics that requires regular washing.

The colour fastness to rubbing of Juco cloth is good. This could find use in dye cloths for rough use. The above tests clearly reveal that Juco fabrics can be used for end uses such as furnishings, upholstery etc, but is not so satisfactory for dress materials. In order to find use in dress materials, Juco fabrics would need suitable after treatments.

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Vol. 37, No. 7, Dec 1992.

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