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when valuable contact between SAWTRI and one of the most important scourers of wool in the United Kingdom was established.

Mr C Hager, Operations Manager (Africa and South America) of Messrs Spinlab, Zurich, Switzerland, spent a few days at the Institute during July when he commissioned the recently acquired Spinlab Fibrograph Plus 810. Detailed information about this ultra-sophisticated instrument is reported elsewhere in the Bulletin.

Mr N Hauffe, Consul (Science and Technology), CSIR, Los Angeles, visited SAWTRI in August where he had discussions with the Chief Director, Dr D W F Turpie on activities at the Institute and with Mr N J Vogt, Regional Representative of the CSIR in the Eastern Cape, on CSIR activities in the area.

SAWTRI information pamphlet

It has been decided to introduce an information pamphlet as an additional means of conveying information to our subscribers.

It will be presented less formally and will contain information mainly on product development or any other topics of general interest and immediate practical value.

SAWTRI PUBLICATIONS

Since the previous edition of the Bulletin, the following Technical Reports by SAWTRI authors have appeared:

No. 522: Smuts, S. and Hunter, L., *Certain Physical Properties of Some Commercial Sewing Threads.*

No. 523: Herbert, D.F., Barkhuysen, F.A. and Van Rensburg, N.J.J., *The Use of N-2, -3-Epoxypropyltrimethylammonium Chloride to Improve the Fixation of Dyes on Cotton. Part I: Reactive Dyes.*

No. 524: Herbert, D.F., Barkhuysen, F.A. and Van Rensburg, N.J.J., *The Use of N-2, -3-Epoxypropyltrimethylammonium Chloride to Improve the Fixation of Dyes to Cotton. Part II: Direct Dyes.*

No. 525: Ball, G.H. and Van der Walt, G.H.J., *The Simultaneous Dyeing, Crease Resist and Flame Retardant Treatment of All-Cotton Fabrics. Part II: A Comparison of Various Resins, Catalysts and Curing Conditions.*

No. 526: Van der Walt, G.H.J. and Van Rensburg, N.J.J., *The Distribution of Resin on Cotton Fabrics. Part II: The Effect of Wet Pick-Up and Drying Rate on Some Physical Properties.*

No. 527: Hunter, L., *A Comparison of the Airflow Measured Fineness Characteristics of Cotton Lap and Sliver Using Different Sample Preparation Techniques.*

Papers by SAWTRI authors appearing in Other Journals.

Van Rensburg, N.J.J., Fire Accidents and Burning Textiles, *J. Diet. and Home Econ.*, **11**, *1* (1983).

Van Rensburg, N.J.J., Toxicology of Fire and Burning Textiles, *J. Diet. and Home Econ.*, **11**, *2* (1983).

New Series

Van Rensburg, N.J.J., Robinson, G.A. and Barkhuysen, F.A., Woven Fabrics from Bobtex Yarns, *SAWTRI Information Pamphlet,* No. 1, August, 1983.

PRODUCTION PROFILE AND PROBLEMS ENCOUNTERED IN THE S.A. CLOTHING INDUSTRY — RESULTS OF A RECENT SURVEY

by S. GALUSZYNSKI and G. A. ROBINSON

ABSTRACT

In 1981 SAWTRI undertook a survey in which 56 leading clothing manufacturers in South Africa participated. From the information collated, a general picture of many of the problems encountered during garment manufacture has emerged.

INTRODUCTION

To clothe the diverse population of South Africa demands a wide variety of garment types. This diversity and the ever changing human requirements make it difficult for the South African Clothing Industry to meet this demand. In fact, some local production has to be supplemented by importation of both fabrics and garments.

Developments incorporating new technology and raw materials lead to an ever increasing number of different fabrics being produced by the fabric manufacturer. New designs and changing fashion and requirements of other industries make it necessary that the clothing manufacturers use a large variety of both products and technologies in the manufacture of garments.

In order to obtain information relating to problems encountered by the S.A. Clothing Industry, SAWTRI undertook a survey in which 56 leading clothing factories participated. The questions put forward referred to: fabric used (raw material, finish etc.), garment production profile, applied techniques and technologies as well as problems encountered during manufacture. A summary of this survey follows:

Range of fabrics

It was found that 82% of respondents used woven fabrics, 54% weft knitted, 40% pile fabrics, 27% non-woven, 54% warp knitted and 9% used some other fabrics.

The survey showed that 23% of companies participating used only locally produced fabrics. The majority (77%), included imported fabrics in their production range which represented an average of about 20% of their total fabric consumption. (Table I shows a summary of fabrics imported into South Africa in 1980).

Fibre content of fabrics

The problems confronting the garment manufacturer become even more complex when various fibre compositions are considered. It can be seen from Table II that 71% of garment manufacturers were using some polyester/cotton blend fabrics, 71% some textured polyester, 61% used 100% cotton and 30% 100% wool fabrics.

Special Finishes

Apparel end uses require specific fabric properties which may demand special fabric finishes (Table III). One of the most common finishes recorded in the survey was the prevention of fabric shrinkage (shrink resistance). Some 41% of apparel manufacturers were using fabrics with a shrink resistant finish; the corresponding figure for crease resistance being 36% and for antistatic 20%.

TABLE I
SUMMARY OF FABRICS IMPORTED INTO SOUTH AFRICA JANUARY — DECEMBER 1980*

TARIFF HEADING		QUANTITY	FOB PRICE (Rand)
Woven Silk Fabrics	(m^2)	216 332	1 061 811
Woven Continuous Fibre Fabrics	(m^2)	38 674 061	43 588 231
Woven Wool and Hair Fabrics	(m^2)	1 813 234	6 775 501
Woven Flax Fabrics	(m^2)	340 822	998 153
Woven Cotton Fabrics	(m^2)	19 596 645	21 769 272
Woven Discontinuous Fibre Fabrics	(m^2)	43 786 870	49 809 191
Pile Fabrics	(m^2)	16 005 266	40 386 717
Narrow Woven Fabrics	(kg)	201 893**	2 329 691
Bonded Fibre and Coated Textile Fabrics	(kg)	3 145 215**	19 991 099
Rubberised and Elastic Fabrics (not knitted)	(kg)	952 335**	6 552 733
Knitted and Crocheted Fabrics	(m^2)	11 032 658	14 308 071
Knitted Elastic and Rubberised Fabrics	(m^2)	1 018 237	2 407 757
TOTAL	(m^2)	132 484 125	
TOTAL	(kg)	4 299 443**	
GRAND TOTAL (Rand)			209 978 227

*Data obtained from customs statistics of fibre imports in 1980.
**Kgs

TABLE II
FIBRE CONTENT OF FABRICS USED BY CLOTHING INDUSTRY

Fire Blend		Number of Clothing Manufacturers
All cotton		34
Polyester/Cotton		40
All Polyester	(a) staple	10
	(b) flat filament	7
	(c) textured	40
Polyester/Viscose		16
All Wool	(a) worsted	9
	(b) woollen	8
Wool/Acrylic		11
Wool/Mohair		4
Wool/Polyester		17
All Acrylic	(a) regular	9
	(b) high bulk	10
Other:		
	(a) other natural fibres	1
	(b) blends	5
	(c) synthetic	20

TABLE III
APPAREL MANUFACTURERS USING FABRICS WITH SPECIAL FINISHES

TYPES OF FINISHES	NUMBER OF COMPANIES
Water repellent	9
Anti-soil	—
Crease resist	20
Antistatic	11
Flame retardant	3
Bonded	6
Prevention of fabric shrinkage	23
Other	5

TABLE IV
NUMBER OF MANUFACTURERS PRODUCING SPECIFIC TYPES OF GARMENTS

TYPE OF GARMENT	MEN'S	WOMEN'S	CHILDREN'S
Overcoats	2	8	0
Raincoats	1	2	0
Suits	5	11	2
Jackets	5	5	2
Trousers	11	9	5
Skirts	0	19	3
Blouses	0	15	4
Dresses	0	14	4
Shirts	5	2	6
Sports wear	8	8	8
Underwear	3	6	6
Jerseys and cardigans	3	4	4

Types of Garments

In isolated instances a particular company would produce only one or two types of garments, but the average number of garment types produced per factory was 4,2. The production of various garment types (Table IV) showed that skirts, blouses and dresses were the most commonly-manufactured articles in the clothing industry, whereas the production of overcoats and rain coats was limited.

Differences in personal welfare of the public in general resulted in some divisions of the industry in respect of product, price and quality. Some 32% of the garment manufacturers reported that their products were aimed at the top end (price and quality), whereas only 12% aimed at the lower end of the market.

Variations in raw materials and the changes in quality and dimensions of textile fabrics can increase the problems encountered by the clothing manufacturer, thereby increasing the demands placed upon the inspection and quality control of both textile fabrics and garments. Fabric inspection, before making-up, was carried out by only 64% of garment manufacturers.

Quality Control

The quality of the final garment depends on the quality of the component parts and skilful application of technologies which requires a relevant in-line quality control within the clothing factory. The survey showed that there is a need for more attention in this field. For example, in the fusing process, the bond peel strength was tested by only 50% of fusing press users, fusing shrinkage was checked by 69%, fusing machine settings required for the accurate fusing temperatures and fusing times by 50% and fusing pressure by only 37%.

PROBLEMS ENCOUNTERED

The making-up of a specific garment is carried out in stages, from laying-up to final pressing. Problems occur at each stage of production and the following were reported in the survey:

Laying-up

Laying-up can be carried out either manually or mechanically. Laying-up by hand was applied by some 89% of garment manufacturers and

TABLE V
PROBLEMS ENCOUNTERED BY CLOTHING MANUFACTURERS DURING LAYING-UP

PROBLEMS	NO OF COMPANIES	TYPES OF FABRIC
Unstrung faults	40	Woven fabrics of polyester, wool, polyester/cotton, wool/polyester, nylon. Knitted fabrics of all fibres.
Fabric width variations	39	Woven fabrics of polyester, nylon, polyester/cotton, wool/acrylic. Knitted fabrics of all raw materials.
Fabric bow and skew	30	Woven and knitted fabrics of cotton, nylon, polyester, polyester/cotton. Checks and stripes.
Colour shade differences: (within one roll)	40	All fabrics (woven and knitted) of various raw materials especially piece dyed.
(between rolls)	36	All fabrics.
Dimensional instability	17	All fabrics

mechanically by 27%. The laying-up of the fabrics may be made either open width or folded; open width was used by 80% of the manufacturers, folded 41%.

The most common problems encountered during laying-up (Table V) were concerned with unstrung faults — some 71% of garment manufacturers reported this problem. Other serious problems reported were variations in colour shade (71%) and variation in fabric width (70%).

Cutting

Various methods were employed in fabric cutting, but the most common methods were the use of the round knife, straight knife and band knife. The common problems encountered during this operation are listed in Table VI. The more frequent ones were fabric distortion and fraying. These problems appeared in both woven and warp knitted fabrics with the former type giving most trouble.

TABLE VI
PROBLEMS ENCOUNTERED DURING CUTTING

PROBLEM	NUMBER OF COMPANIES
Blade damage (blunting, abrasion)	10
Fabric damage	10
Fabric distortion (fabric movement, fabric shrinkage after cutting)	19
Fraying (fraying after cutting, especially woven fabrics and some warp knitted)	11

Fusing

By applying pressure and temperature for a certain time to an outer fabric and interlining with adhesive, the two fabrics become fused together. As a result of the fusing process, the fabric can change its dimensions and this causes problems for garment manufacturers (Table VII).

Table VII shows that there is a strong need for an improvement in fabric dimensional stability. Fabric shrinkage due to fusing can be partially regained if the fabrics, after fusing, are given enough time to recover, which is especially true for worsted and woollen fabrics.

TABLE VII
PROBLEMS ENCOUNTERED DURING AND AFTER FUSING

PROBLEM	NO OF MANUFACTURERS
Bond failure in dry cleaning (fronts)	1
Bond failure in washing (fronts)	1
Shade changes (all parts)	8
Fabric dimensional changes (all parts)	21
Glazing or pile flattening (collars, flaps)	2
Strike through or strike back (fronts, facings)	7

TABLE VIII
NUMBER OF GARMENT MANUFACTURERS AND PROBLEMS ENCOUNTERED DURING SEWING

PROBLEM	NO OF MANUFACTURERS
Needle breakage (all fabrics, all raw materials)	11
Needle heating (all fabrics, especially blends and synthetics)	18
Seam puckering (all fabrics, especially blends and synthetics)	28
Seam slippage (all fabrics, especially polyester/ cotton and 100% synthetics)	17
Seam breakdown (all fabrics, especially polyester cotton and 100% synthetics)	7

Sewing

Sewing is the principal operation in the clothing industry. It is during this operation that many problems associated with sewing threads, needles, seams and fabric manifest themselves. All these can affect the quality of the seam in terms of strength and stability. Problems that arose during the sewing operation are shown in Table VIII. They were seam puckering, needle breakage, needle heating and seam slippage. These were found to occur when sewing all kinds of fabrics, independently of fabric raw material.

Some of these problems, viz. seam puckering, seam slippage, needle heating require further investigation.

Pressing

The final stage in the garment manufacturing process is pressing. Problems related to pressing were concerned with dimensional stability of fabric and seams (Table IX). The most common ones being fabric shrinkage, seam puckering and steam impressions and creasing. Some of these faults could be avoided by careful operators.

TABLE IX
PROBLEMS ENCOUNTERED DURING PRESSING

PROBLEM	NO OF MANUFACTURERS
Fabric shrinkage	17
Seam puckering	11
Steam impressions	10
Creasing	6

General problems summarised

The general problems associated with fabrics received by the clothing manufacturers can be expressed by the number of firms (%) reporting the problems as shown below:

— unstrung faults	71
— piece shading	39
— fabric dimensional instability	38
— variations in fabric width	36
— too many fabric faults	30
— incorrect finishing	21
— variations in piece lengths	18
— late delivery	18
— variation in fabric properties	11
— difficulties in design matching	9

— problems with selvedges 7
— discrepancies between order and delivery 7

Variations in shade of sewing threads also caused problems.

CONCLUSION

The information gathered from the survey emphasises the complexity of the SA Clothing Industry. The demands imposed on this industry to clothe the people of South Africa require versatility in both production and application of new technologies. The basic raw materials for this industries are fabrics and threads, and the results show that there are a number of problems to be solved in order to assist the clothing manufacturers to be more efficient and effective in their production processes, viz:

— improvement in fault marking and
— consistency in fabric dimensions, length and width.
— improvement in quality of dyeing (elimination of shading)
— improvement in fabric general quality (reduction of number of faults)
— improvement in dimensional stability of fabrics
— improvement in finishing
— reduction in fabric distortions — bowing and skewing.

The most serious problems encountered during garment manufacture were:
— seam puckering
— needle heating during sewing
— optimisation of seam structure
— fabric shrinkage during fusing and pressing
— fabric displacement during cutting.

USE OF PROPRIETARY NAMES

The names of proprietary products where they appear in this report are mentioned for information only. This does not imply that SAWTRI recommends them to the exclusion of other similar products.

ACKNOWLEDGEMENTS

The authors are grateful to all the companies who participated in the survey for their efforts and co-operation in making this report possible. Thanks are also due to Mr M P Cawood and Mr V G Russell for their contribution in the preparation of the questionnaire.

THE PROCESSING OF *Phormium tenax* IN BLENDS WITH COTTON AND POLYESTER ON THE SHORT STAPLE SYSTEM

by K.W. Sanderson and H. Taylor

ABSTRACT

Phormium tenax *fibre, having been chemically softened and cut, was blended with either cotton or polyester and processed on the short staple system. Blends (30 : 70) were spun to 50 tex yarns on a conventional cotton ring frame and 50:50 blends were spun to 100 tex yarns on a Dref II machine. Blowroom and card wastes were high and the card cylinder tended to overload. End breakage rates were high during ring spinning, while Dref II spinning was more satisfactory. The phormium/polyester blends processed more satisfactorily and produced the stronger yarns.*

INTRODUCTION

Similar to jute (*Chorchorus spp*), a related vegetable fibre plant, the fibre derived from *Phormium tenax* has commonly been used for the manufacture of coarse packaging materials such as grain bags, and for other commercial end-uses. In acknowledgement of its viable production potential in Southern Africa, particularly in regions where agriculture needs to develop from a subsistence to a commercial level, attention has recently been given to exploring ways and means by which the end-uses of phormium fibre can be diversified.

Expanded utilisation, however, has necessitated modification of the fibre in terms of splitting the fibre bundles into finer bundles, and softening. Weideman and Grabherr[1] showed that phormium could be satisfactorily softened and further broken down when subjected to batchwise sodium hydroxide and sodium hypochlorite treatments. Fibre thus treated was whiter and softer than the untreated fibres, with no loss of strength when dry, although wet tenacity was poor. The fibre was then blended with acrylic fibres in a 70:30 phormium-rich ratio and a 225 tex yarn was satisfactorily spun and woven into an attractive fabric.

This softening process was refined by Weideman and Van der Walt[2] using both chemical and mechanical means. They showed that it was possible to use sodium hydroxide on its own as a softening agent by treating the fibre under pressure. Softening was also improved by increasing the caustic soda concentration. The largest single improvement in the handle of the fibre was found when the still-wet chemically-softened fibres were repeatedly passed through sets of squeeze rollers.

Further modifications of the basic softening treatment were attempted by Weideman and Robinson[3], who found that softening without a detergent, followed by a cold rinse, lubrication and one squeezing, generally produced the finest and strongest fibre. They went on to spin successfully R200 tex yarns on the Dref II system using two different cores, a 40 tex polypropylene yarn and two 40 tex polyester/cotton (50:50) yarns. These yarns were woven as weft in curtaining fabrics which had a natural rustic appearance, were attractive and had satisfactory draping qualities.

More recently, Frazer[4] has shown that phormium fibre can also be successfully softened using a cyclic treatment involving sodium metasilicate followed by squeezing. Frazer further introduced the concept of cutting the phormium fibre into shorter lengths and blending with cotton as a carrier. In this way, the spinning of phormium/cotton blends into 50 to 100 tex yarns on the ring, rotor and Dref systems was shown to be possible.

With the continuing objective of diversifying phormium's potential end-uses, this investigation was initiated to attempt to produce phormium-blend yarns using the short staple processing system which would be suitable for constructing an upholstery fabric in a straw cloth, having a mass of 350-450 g/m^2, and a panama-type tropical suiting fabric of mass about 180 g/m^2. This report describes the processing of phormium fibre with either cotton or polyester to produce yarns suitable for weaving such fabrics.

EXPERIMENTAL

The production of four yarns incorporating a blend of phormium with either cotton or polyester, were planned as shown in Table I:

TABLE I
YARN PRODUCTION PLAN

Blend	Spinning System	Yarn linear density (tex)
30:70 Phormium/cotton	Ring	50
30:70 Phormium/polyester	Ring	50
50:50 Phormium/cotton	Dref II	100
50:50 Phormium/polyester	Dref II	100

Materials

Phormium tenax: The decorticated fibre was cut and softened according to Frazer; the sequence consisted of cutting to ± 40 mm, opening, softening with an eight-fold sequence of soaking in sodium metasilicate followed by squeezing, oiling and drying.

Cotton:	Deltapine 5826 Dirk	
	2,5% Span length	27,7 mm
	Fibre fineness	203 mtex
	Micronaire	4,3

Polyester: Trevira, type 120, semi-dull, 1,5 dtex, 38 mm staple
Polyester filament: Hoechst, 167 dtex, f34 textured.

Blending, Blowroom and carding

The fibre blends were formed in the required ratios by hand using a sandwich mix method prior to the blowroom sequence (Plates 1 and 2). Each batch was opened, cleaned, blended and formed into laps in a blowroom line incorporating three cleaning points (porcupine beater, two-bladed beater and Kirschner beater). Carding was carried out on a conventional cotton card at a production rate of 7,5 kg/hr.

Drawframe and speedframe

After carding, all four blends were passed through the drawframe twice. The two 30:70 blends, destined for conventional ring-spinning, were then passed through the speedframe, producing rovings of 663 and 672 tex for the phormium/cotton and phormium/polyester blends, respectively. The two 50:50 blends, destined for friction spinning on the Dref II system, were retained as slivers of 5,0 ktex.

Spinning

Rovings from the two 30:70 blends were spun on a conventional ring-spinning frame at 8000 rev/min to a 50 tex yarn and with a twist factor (tex) of 38. End breakages were recorded.

Slivers from the two 50:50 blends were spun on the Dref II friction spinning system to a 100 tex yarn using a 167 dtex, f34, textured polyester filament core. Sliver was fed in at 0,8 m/min (setting 160), yarn was delivered at 150 m/min, (setting 547) and twist was imparted with a drum speed of 2 700 rev/min setting 760).

RESULTS AND DISCUSSION

Processing performance

The proportions of waste extracted in the blowroom and during carding are giving in Table 2.

TABLE 2
WASTE EXTRACTION DURING OPENING AND CARDING

Blend	Waste (%)	
	Blowroom	Carding
30:70 Phormium/cotton	2,2	13,3
30:70 Phormium/polyester	1,6	10,0
50:50 Phormium/cotton	4,2	19,6
50:50 Phormium/polyester	3,7	18,6

The majority of the waste consisted of hard unsplit bundles of phormium fibres. The 50:50 blends generated the most waste, while the phormium/cotton blends produced more waste than the phormium/polyester blends. The latter effect was due to the extraction of cotton trach and short fibres in addition to phormium wastes. A total of 23,8% waste was extracted from the 50:50 phormium/cotton blend.

In addition to excessive extraction as flat-strip waste, mainly composed of larger phormium fibre bundles, the card cylinder repeatedly overloaded with fibre bundles, necessitating hand-clearing and creating excessive stoppages in both practical and commercial terms. The 50:50 blends were particularly troublesome in this respect.

Higher waste extraction rates can be expected when a coarse fibre like phormium is processed through the short staple (cotton) system, but it is believed that a greater degree of softening and more extensive fibrillation would achieve more favourable results.

No problems were encountered in producing appropriate sliver and rovings, although irregularities were naturally somewhat higher than normally experienced with cotton or polyester blends. Details of linear densities and irregularities are given in Table III.

Spinning performance

The spinning of a 50 tex yarn from the two 30:70 blends on a conventional ring-spinning system was achieved only with difficulty.

TABLE 3
LINEAR DENSITIES AND IRREGULARITIES OF SLIVERS AND ROVINGS

Blend	Card sliver	Drawframe sliver				Speedframe roving	
		1st pass		2nd pass			
	ktex	ktex	Irregularity (CV%)	ktex	Irregularity (CV%)	Tex	Irregularity (CV%)
30:70 Phormium/cotton	4,8	4,6	5,0	4,5	5,3	663	10,0
30:70 Phormium/ polyester	5,0	4,8	5,6	4,4	5,9	672	12,4
50:50 Phormium/cotton	4,9	4,4	7,0	5,0	7,5	—	—
50:50 Phormium/ polyester	4,3	4,8	6,0	5,0	7,6	—	—

The end breakage rate of the 30:70 phormium/cotton blend was very high at 1 700 breaks per 1 000 spindle hours. A test-run with a reduced spindle speed, 6 500 rev/min, reduced the rate only slightly, to 1 600 breaks per 1000 spindle hours. The end breakage rate of 30:70 phormium/polyester blend was considerably lower at 460 breaks per 1 000 spindle hours, and this was further reduced to 140 per 1 000 spindle hours by changing the platform in the bottom cradle, thereby facilitating drafting but losing some fibre control.

End breakage rates were far in excess of those normally accepted, with the phormium/polyester blend, however, performing considerably better than the phormium/cotton blend. Machine adjustments were moderately successful in reducing end-breaks and it is possible that increased softening and fibrillation would further improve spinning performance. A significant amount of fly, mainly derived from phormium, was noted at the spinning frame.

Construction of a 100 tex yarn with the 50:50 blends on a Dref II friction spinning system using a polyester filament core was entirely satisfactory and presented little practical problems.

Yarn properties

Some physical properties of the four phormium-blend yarns are given in Table 4.

The major characteristics of the yarns were the high degree of irregularity and large number of imperfections. The introduction of either cotton or polyester in blends with phormium has, however, facilitated the processing of phormium on the short staple system which would not otherwise have been possible.

Yarn strengths varied but the strongest was decidedly the 30/70 Phormium/polyester blend spun to 50 tex on the conventional ring system.

TABLE 4
THE EFFECT OF BLEND COMPONENT, BLEND RATIO AND SPINNING SYSTEM ON YARN PHYSICAL PROPERTIES

Blend	30:70 Phormium/ Cotton	30:70 Phormium/ Polyester	50:50 Phormium/ Cotton	50:50 Phormium/ Polyester
Spinning System	Ring	Ring	Dref II	Dref II
Linear density: Nominal (tex)	50	50	100	100
Mean (tex)	50,7	49,3	100,7	101,2
CV (%)	1,9	0,8	1,7	1,2
Breaking Strength:				
Mean (cN)	475	1070	870	900
CV (%)	14	8	5	7
Tenacity (cN/tex)	9,4	21,7	8,6	9,8
Extension at Break (%)	6,7	14,1	17,0	14,3
Irregularity: (CV %)	25,1	27,2	20,2	25,8
Thin places (per 1000m)	370	390	130	1170
Thick places (per 1000m)	1980	2030	810	1860
Neps (per 1000m)	3580	2220	2640	4090
Hairiness: Number (per m)	37	12	40	32
CV (%)	15	46	47	48

— With polyester filament core

Due to the apparently heavy losses of phormium in the blowroom and during carding and ring-spinning, the two 30:70 ring-spun yarns were analysed for components with the following results —

Phormium/Cotton 34 : 66 (approx.)
Phormium/Polyester 20 : 80 (approx.)

It seems, therefore, that cotton losses were similar to phormium losses but that polyester losses were significantly less than phormium losses.

SUMMARY AND CONCLUSIONS

Phormium tenax fibre having been chemically softened and cut, were blended with either cotton or polyester and processed on the short staple system, including blowroom, carding, drawframe and speedframe; 30:70 phormium/cotton and phormium/polyester blends were spun to 50 tex yarns on a conventional cotton ring-spinning frame and 50:50 phormium/cotton and phormium/polyester blends were spun to 100 tex yarns on a Dref II friction machine.

Waste extraction rates were high in the blowroom and during carding and the card cylinder became repeatedly overloaded, requiring hand-clearing. With ring spinning, excessive fly was noted and end-breakage rates were high, although significant improvements were achieved with small machine adjustments. The phormium/polyester blend was significantly better in this regard. Dref II spinning of the 50/50 phormium/cotton and phormium/polyester 100 tex yarns proceeded satisfactorily.

The majority of the waste was identified as incompletely opened phormium fibre bundles; it is possible that further softening may reduce the amount of waste.

The yarns showed characteristic unevenness and relatively large numbers of imperfections. The 30/70 phormium/polyester blend, ring-spun to 50 tex was the strongest yarn.

It may be concluded that softened and cut *Phormium tenax* fibres can be processed in blends with either cotton or polyester on the short staple (cotton) system producing ring-spun yarns of 50 tex with an attractive linen type appearance, and friction-spun yarns of 100 tex with a natural, rustic appearance.

Further research is now in progress to convert these yarns into fabrics suitable for either topical suiting or upholstery, followed by their finishing.

THE USE OF PROPRIETARY NAMES

The names of proprietary products where they appear in this report, are mentioned for information only. This does not imply that SAWTRI recommends them to the exclusion of other similar products.

ACKNOWLEDGEMENTS

The authors thank the staff of the Short Staple Processing and textile Physics Departments of SAWTRI, who gave technical assistance in this project. Permission by the Department of Industries to publish this report is gratefully acknowledged.

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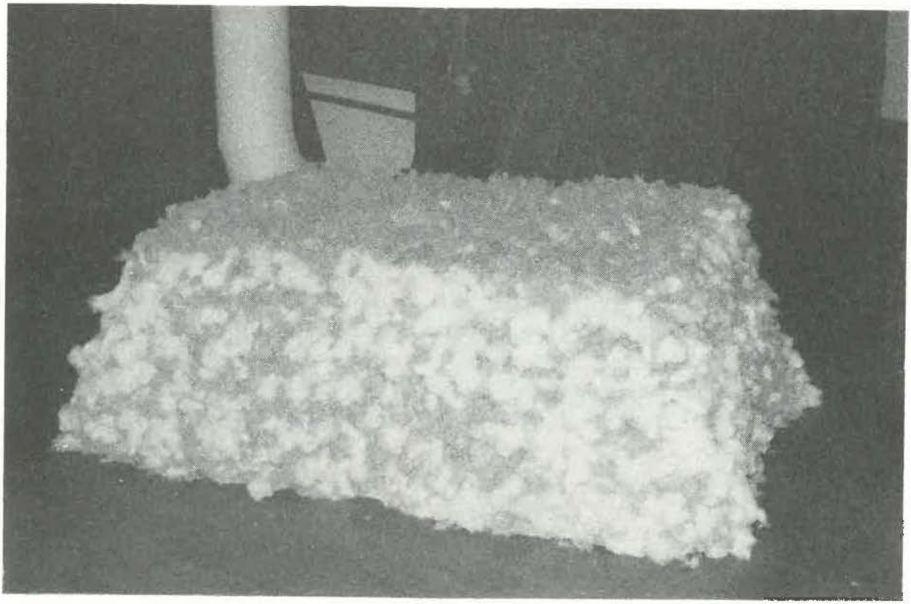

PLATE I: *Phormium tenax;* Cotton blend. Sandwich-mix prior to blowroom sequence.

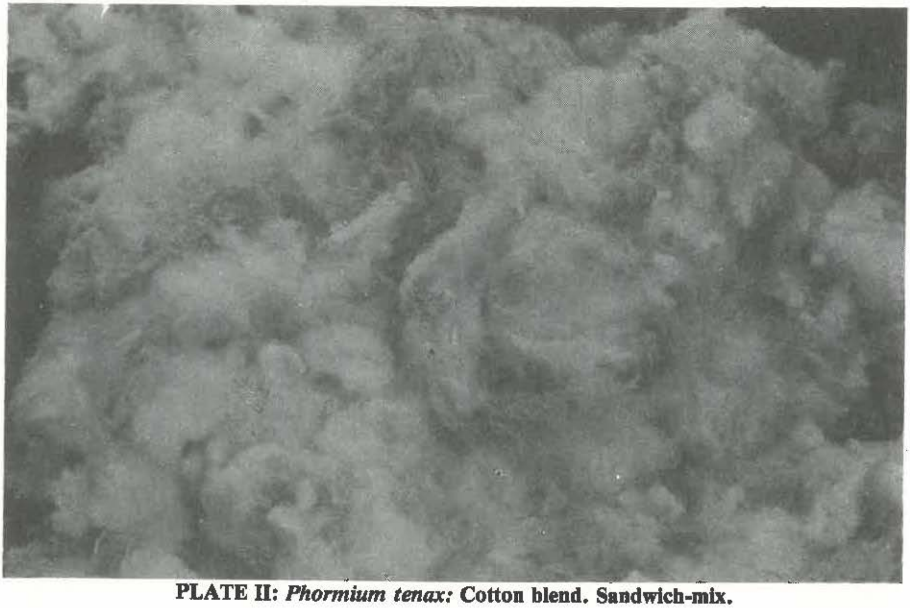

PLATE II: *Phormium tenax:* Cotton blend. Sandwich-mix.

AN INTRODUCTORY STUDY OF THE USE OF SODIUM METASILICATE FOR SOFTENING AND THE SHORT STAPLE SYSTEM FOR PROCESSING *Phormium tenax*

by W FRAZER

ABSTRACT

A series of short experiments was carried out on the softening and subsequent processing, on the short staple system, of Phormium tenax *fibre. The use of sodium metasilicate as a softening agent gave good results, and the softened fibres could be processed, after cutting, in 50/50 blends with cotton into ring, rotor and Dref yarns of approximately 100 tex. Relatively high levels of phormium-rich waste were recorded during processing.*

INTRODUCTION

The chemical softening and processing of *Phormium tenax* fibres have been investigated by SAWTRI[1-3] and it was shown that by softening the fibres, finer yarns could be spun thus increasing the number of potential end uses for the fibre. One such development, which has been reported[3], involved the use of phormium fibres in the production of curtaining fabrics having an attractive natural rustic appearance, and a good drape.

In an effort to produce even finer yarns, thereby still further increasing the number of potential end-uses for the fibre, it was decided to extend the work on softening using another softening agent. Furthermore, it was decided to investigate the mechanical processing of the fibre so obtained, along the short staple (cotton) route in blends with another cellulosic fibre, such as cotton.

EXPERIMENTAL

Preliminary

Preliminary experiments in the laboratory using sodium metasilicate as a softening agent at varying concentrations and various immersion times gave encouraging results and led to further experiments on a small scale softening plant.

Softening plant

The softening plant consisted of a long stainless steel tank through which the fibre was propelled by stainless steel blades carried on an endless plastic belt. The transit time of the fibre through the metasilicate solution was 2 minutes. Circulation of the liquor was provided by a centrifugal pump and the liquor was heated to 95°C by an immersed steam coil.

The squeeze rollers consisted of a set of steel rollers, one of which was knurled and the other plastic covered, with a continuous fabric belt passing between the rollers and on which the fibre was placed. Pressure between the rollers was provided by a pair of hydraulic rams fed from a pressure intensifier. A force of 800 Newtons was exerted at the nip.

Softening Process

Softening was carried out as follows:

Fibres which had been decorticated on a Corona decorticator, were cut to approximately 40 mm in length in a semi-automatic cutter and then passed through an opening willey to break down the fibre clusters which formed during cutting. The cut and opened fibres were then passed through a trough, containing a hot solution of softening agent, followed by squeezing. This action was repeated a number of times, as required. After this, the fibres were oiled, squeezed, dried in hot air and passed once more through the opening willey.

Experiment I

A 2x3x3 factorial experiment was carried out on the small scale plant with the following variables.

1. Chemical softening agents: Sodium hydroxide and sodium metasilicate.
2. Number of cycles through system: 2, 4 and 8 times.
3. Concentration of softening agent: 0,5; 1,0 and 2,0% (m/v).

Experiment II

Based upon the results of Experiment I (see Results and Discussion), a larger (20 kg) batch of fibre was subjected to 8 cycles in a 0,5% m/v solution of sodium metasilicate, followed by oiling and drying. The fibre was then passed through the opener after which it was blowroom blended with cotton in the ratio 30% phormium/70% cotton with a view to using cotton as a carrier fibre. The resultant lap was carded on a cotton card and finally spun on the ring, rotor and Dref systems.

Experiment III

A further quantity of *Phormium tenax* fibre, softened using sodium metasilicate in the pilot softening plant, was dyed prior to blending with undyed cotton with the aim of establishing the amount of fibre lost during the various processing stages, and therefore the final composition of the blend. Two blends were produced from the dyed phormium, namely 50/50 phormium/cotton and 70/30 phormium/cotton. The same processing route

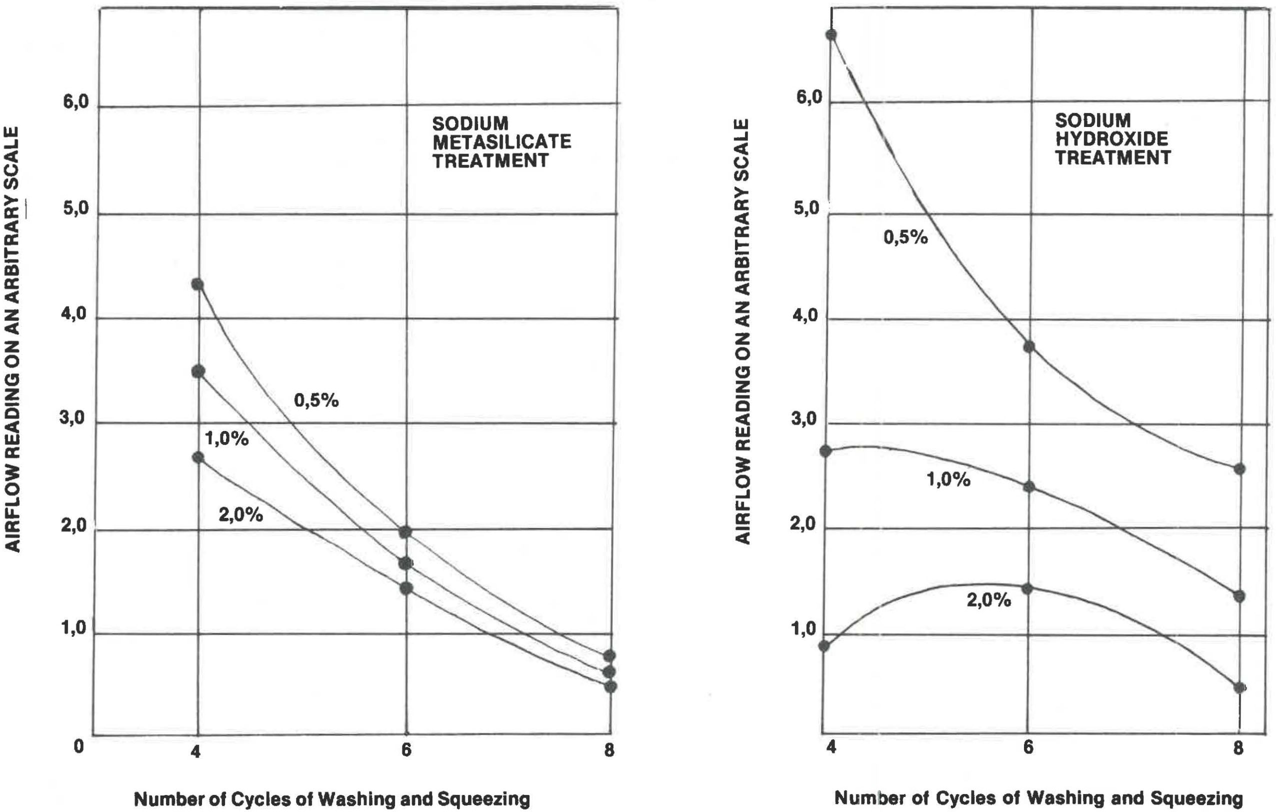

Fig. 1 — Airflow Readings versus Number of Cycles of Washing and Squeezing for *Phormium tenax* treated with two Reagents and at three concentrations.

was used as in the previous experiment and spinning carried out on the ring, rotor and Dref systems.

RESULTS AND DISCUSSION

Experiment I

A subjective appraisal of the 18 samples obtained was made in an attempt to place the samples in the order of apparent softness and paleness of colour. At the same time, the softened fibre "fineness" was measured on the air-flow apparatus and an excellent correlation was found between the subjective (handle) assessment and the air-flow measured fineness.

The results of the 18 tests are shown in Fig. 1 and from this it is apparent that the "fineness" improved with the number of cycles of washing and squeezing and that, at 8 cycles, there was a significant difference between hydroxide treated samples and those which had been treated with sodium metasilicate. Furthermore, the metasilicate treated samples were lighter in colour.

Experiment II

The results of the second experiment demonstrated that yarn linear densities of 40 to 80 tex are possible on the ring; 50 to 100 tex on the open-end and 150 to 200 tex on the Dref from such a cotton/phormium blend.

Experiment III

The waste produced at the various processing stages are shown in Table I for the two blends of phormium and cotton. The percentages of phormium and cotton are indicated in each case, these being estimated visually from the colour of the waste using specially prepared samples as a basis of reference. Final blend ratios and yarn yields are shown in Table II.

TABLE I
WASTE PRODUCED AT VARIOUS STAGES

STAGE	50% *Phormium tenax*/ 50% Cotton			70% *Phormium tenax*/ 30% Cotton		
	% Phormium	% Cotton	Total	% Phormium	% Cotton	Total
Blowroom	1,5	1,5	3	2,5	1,5	4
Card	10	5	15	8	4	12
Drawframe	—	—	1	—	—	1
Spinning: Rotor	12	2	14	23	2	25
Ring	2	2	4	7	8	15
Dref	3	1	4	4	2	6

From Table I it is clear that a considerable amount of waste was produced during processing, with the waste being predominantly phormium. Particularly high waste percentages were recorded during carding even though the flat waste was re-cycled during the carding operation. From Table II it is clear that the highest yarn yields were obtained with the Dref and ring spinning systems and that these systems also produced the least change in blend ratio.

In spite of the high percentage of waste produced during processing it was possible to spin yarns of 100 tex from the 50/50 blend successfully, particularly using the ring and Dref systems, thereby extending the end use potential of *Phormium tenax* fibre. The yarns had an interesting appearance resembling linen and some further work to exploit this is in progress.

The blend containing 70% phormium did not spin satisfactorily, indicating that not more than 50% phormium should be incorporated when attempting to spin yarns as fine as 100 tex. (See Table II.)

TABLE II
FINAL BLEND RATIOS AND YARN YIELDS

Spinning Method	Initial Blend 50/50			Initial Blend 70/30		
	Phormium %	Cotton %	Yarn Yield %	Phormium %	Cotton %	Yarn Yield %
Rotor	41	59	70	64	36	62
Ring	47	53	78	75	25	71
Dref	46	54	78	71	29	78

THE USE OF PROPRIETARY NAMES

The names of proprietary products where they appear in this report, are mentioned for information only. This does not imply that SAWTRI recommends them to the exclusion of other similar products.

ACKNOWLEDGEMENTS

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