SAWTRI BULLETIN

SOUTH AFRICAN
WOOL TEXTILE RESEARCH INSTITUTE
OF THE CSIR
P.O. BOX 1124
PORT ELIZABETH

VOL. 10 DECEMBER, 1976 NO. 4

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Editor: M. A. Strydom, M.Sc.

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EDITORIAL

It is again a pleasant task to wish, on behalf of the Director and staff of SAWTRI, all our readers a most enjoyable festive season and a prosperous new year. On the commercial and economic fronts South Africa has had a year of unease, although it seems that the textile industry has managed to weather most of the setbacks of the past year. Despite all the trials and tribulations of 1976, at the end of this year the Institute can look back over 25 years of service to the textile industry. A highlight of our 25th year was the commencement of a further extension of our present buildings to provide facilities for our ever-increasing research, testing and related activities. Over the 25 years of the existence of SAWTRI as a research establishment, steady expansions have provided the means for housing more sophisticated research and development facilities in order to keep pace with scientific and technological developments from overseas. It can also be stated unequivocally that over 25 years a vast bank of data relating to technical, technological and scientific information has been established, a source from which industry can draw whenever required. However, capital investments in terms of building additions, new processing and testing equipment and appointment of additional research and technical staff can only be warranted if it fulfils the second of the CSIR's four main aims, namely "the study of technological innovation as a factor in industrial development, and services in connection with production technology". Within the framework of this statement of policy it should be stressed therefore that SAWTRI provides a *service* to industry. Textile mills, on an individual or on a corporate basis, should therefore make an effort to use this service, be it on the level of technical enquiries, contract research or confidential research and development projects. Benefits derived from collaboration of this kind will not only be in the interest of the textile industry as such but also in the interest of our national economy.

A special word of thanks is due to all organisations, private, statutory and governmental, who have financially supported the Institute over the past 25 years. We believe that their continued moral and financial support will bear fruit on both the short and the long term. The staff of SAWTRI, past and present, is also thanked for their loyal support, congratulated on achievements attained and also wished a happy and prosperous future.

INSTITUTE NEWS

Meetings of research steering committees and advisory committees

It is the policy of the Institute to plan and direct research in collaboration with bodies sponsoring particular projects, bodies such as the Wool Board, Mohair Board and the Rhodesian Cotton Promotion Council. The steering committees of the Mohair Board and the Cotton Promotion Council met on the 20th October and 1st November, respectively, to discuss progress reports and proposed projects for the 1977/78 fiscal year. The Wool Board steering committee met on November 23rd for similar discussions We remain thankful to these organisations for their continued support of local research.

The Research Advisory Committee met on 24th November for their annual meeting. This body, with Dr C. van der Merwe Brink, president of the CSIR as chairman, screens and approves proposed national research projects and functions in an advisory capacity to the CSIR.

The inaugural meeting of the Textile Co-ordinating and Development Committee of the Water Research Commission was held in Durban on 28th October to plan the investigation of water management and effluent treatment in the textile industry. SAWTRI is represented by the Director on this committee.

Visits and Visitors:

On 27th October the Minister of Agriculture, the Hon. H. Schoeman together with his Deputy, Mr J. J. Malan, Mr S. A. D. van Schalkwyk, Secretary for Agricultural Economics and Marketing, Messrs G. Joubert and J. Moolman of the South

From left to right Mr J. J. Malan, Mr Gideon Joubert, Min. Hendrik Schoeman, Dr D. P. Veldsman, Mr S. A. D. van Schalkwyk, and Mr J. Moolman during a recent visit to SAWTRI

African Wool Board and Professor B. C. Jansen, Director of Agricultural Technical Services visited the Institute. The purpose of the visit of the Minister was to attend the official opening of the new laboratory facilities of the Technical Services Department of the Wool Board and to familiarise himself with, inter alia, textile research at SAWTRI. During the afternoon, the Wool Board also held a meeting in the SAWTRI Board room.

Various industrialists have also visited SAWTRI over the past three months. These included a visit by a large delegation of Italian textile businessmen. The purpose of these visits was technical discussions with various staff members as well as familiarisation with the research activities at the Institute.

The Director and Dr D. Turpie attended the 12th meeting of the S.A Advisory Committee of the Textile Institute in Durban on September 20th. It was decided at this meeting to convene a symposium during the second half of 1977, the venue most likely to be Port Elizabeth. The proposed theme of the symposium will be "New trends in fabric manufacture"

Mr N. J. Vogt, Regional Liaison Officer attended the Textile Fabrics Fair held in Johannesburg on 28/29th September. This Fair, the first of its kind to be held in South Africa and organised by the Textile Federation attracted some 18 exhibitors and was, in the opinion of many, an unqualified success – on the first day alone the Fair was visited by 387 firms, including buyers from several large retail outlets.

Messrs Vogt and Strydom also visited a large number of textile firms in the Durban/Pinetown/Pietermaritzburg area from the 12th to 18th September. The purpose of these annual visits to industry includes courtesy calls on SAWTRI subscribers as well as visits to non-subscribers with a view to introducing the Institute and its activities to such firms.

Drs D. P. Veldsman, L. Hunter and Mr G. A. Robinson attended a symposium on the Interdependence of the Textile and Clothing Industries organised by the South African Bureau of Standards and held in the Elangeni Hotel, Durban on the 9th and 10th November. The purpose of this symposium was to provide the opportunity for discussing the differences in opinion between the local manufacturing and clothing industries, particularly with respect to the measurement and interpretation of fabric defects. On this occasion Dr Hunter presented a review paper on the causes and measurement of knitted fabric barré.

New subscribers

We wish to welcome a number of new contributors to SAWTRI. With only a few exceptions, all the important textile firms in South Africa now subscribe to the work of the Institute. It is extremely encouraging to have the moral support of the industry in the form of an annual subscription to the various publications of the Institute. These firms, together with our other subscribers will now be visited on a regular basis and will be kept up to date with our research activities.

The new subscribers are the following –

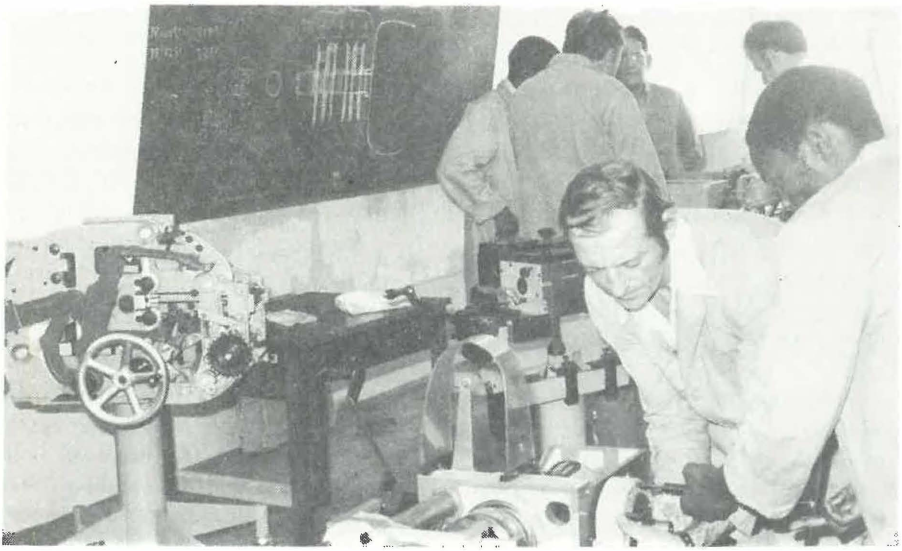
The Good Hope Textile Corporation, King William's Town

Rosedale Textile Mills, Pietermaritzburg
S.A Hosiery Manufacturers, Johannesburg
Smith and Nephew, Pinetown
Fabrina Fabrics, Pinetown
Hebox Textiles, Hammarsdale
Consolidated Fine Spinners and Weavers, Mobeni

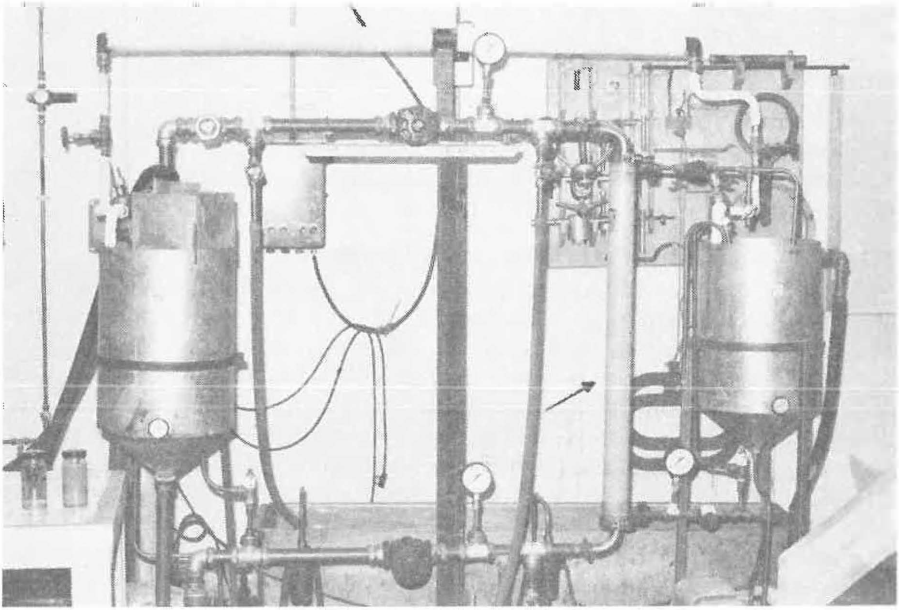
We look forward to close and mutually beneficial cooperation with these firms.

Latest acquisitions in Testing and Processing Equipment

Messrs Crosrol of Halifax, represented in South Africa by Messrs A. H Marcuson, has undertaken to equip SAWTRI with a tandem card. For this purpose SAWTRI will supply two Platt cards. We are greatly indebted to Messrs Crosrol for this wonderful gesture of goodwill, especially now that SAWTRI is actively engaged in research on OE spinning and the removal of trash and micro-dust from cotton. Subscriber firms are invited to visit the Institute for discussions on possible trials using our tandem carding/OE spinning plant. The Schubert and Salzer (Ingolstadt) OE spinner with 24 rotors has also now been installed. This will increase SAWTRI's OE spinning facilities considerably as until recently, the small Rieter Rotondo (6 rotors) was the only OE-spinner available. In the field of conventional ring spinning, the Institute's Platt M1 ringframe has been fitted with a modern Casablanca drafting system.



Sulzer technicians seen here giving instructions on the basic operation and servicing of Sulzer looms



The Ultrafiltration plant for the treatment of wool scouring effluent. The Romicon unit consisting of membrane-lined hollow fibres is indicated by the arrow

The range of equipment for effluent treatment in the Scouring Department has been extended by the addition of a Romicon hollow fibre ultrafiltration unit. The heart of the unit is a collection of membrane-lined hollow fibres through which the contaminated liquor is pumped. This apparatus is to be used in various projects involving studies on the treatment of wool scouring effluent.

In the Knitting Division, the 18 gauge Wildt Mellor Bromley 8RD double jersey machine has recently been fitted with Triplite positive feed units and Faneknit laying-in units. These two new developments in non-slip tape/capstan yarn feeding and patterning mechanisms are to be evaluated in the near future.

The Textile Physics and Testing Division has purchased an L & M sewability tester from the UK. This apparatus measures the force of needle penetration during sewing. This force is directly proportional to the sewability of the fabric. The forces which can be generated by high frictional restraints will cause either yarn or needle breakages or both, or will in turn generate heat which can cause fabric fusing during high speed sewing. It is hoped that this piece of equipment will prove very useful in certain research projects as well as provide an additional service to firms with technical enquiries on lubrication, sewability and related problems.

The Textile Physics and Testing Division's new L & M sewability tester for measuring forces generated during sewing

The SAWTRI wrinkle tester has also been modified to the extent that recording, feedback and computation of results are now automated with the aid of an electronic recorder and the Institute's Wang computer. This is the topic of a technical article appearing on page 27 of this Bulletin.

Participants in the recently-held Uster training course held in the SAWTRI lecture room. This very successful course was organised through Messrs Texmaco, local representatives of Zellweger Uster Ltd

Staff matters

Dr J. P. M. Brandt has been appointed Senior Research Officer as from 2nd November, 1976. Dr Brandt obtained his Ph D.-degree at Stuttgart University in 1975 and was attached to the Institute of Textile Chemistry at the same university. Before coming to South Africa, Dr Brandt was involved in research in polymer chemistry with Messrs Enka Glanzstoff

Mr J. P. van der Merwe has been appointed Chief Research Officer in charge of Cotton Processing. Mr van der Merwe spent seven years at SAWTRI (from 1967 to 1973) before leaving for Industry He obtained an M Sc.-degree from the University of Stellenbosch in 1964.

Mr P. A. Anderton has been appointed Assistant Research Officer in the Cotton Processing Department. Mr Anderton obtained a B Tech.-degree (with honours) from the University of Bradford in June of this year

We wish to welcome these new staff members to SAWTRI and hope that their stay will be long and happy

Mr J. Klazar, Head of the Machine Development Section, has been registered as a Professional Engineer with the South African Council for Professional Engineers. We wish to congratulate Mr Klazar upon receiving recognition of his academic qualifications and practical experience in mechanical engineering from this prestigious body

SAWTRI PUBLICATIONS

Technical Reports

No. 320 : Weideman, E., Studies on the Surface Chemistry of Wool, Part I: The Surface Free Energy of Diiodomethane (August 1976).

No. 321 : Roberts, M. B., A Method for the Removal of Chromium from Chrome Dyeing Effluent (September 1976).

No. 322 : Schmidt, H. E and Turpie, D. W. F., The Effect of Atmospheric Conditions, Regain before Carding and Water added during Gilling on the Processing Performance of Faulty Wools up to Combing (September 1976).

No. 323 : Hunter, L., The Influence of Mean Fibre Diameter and Variation in Fibre Diameter on the Physical Properties of Wool Punto-di-Roma Fabrics (September 1976).

No. 324 : Horn, R. E., The Simultaneous Dyeing and Crease-Resist Finishing of Cotton with Acid Dyes and Resin Precondensates, Part III: A Study of Some Resin Precondensates (September 1976).

No. 325 : Hunter, L., Dobson, D. A. and Cawood, M. P., The Relationship between Certain Properties of Wool Worsted Yarns and their Knitting Performance, Part III: Effect of Fabric Structure (October 1976).

No 326 : Horn, R. E., A Novel Method for the Crease-Resist Finishing and Dyeing of Cotton Fabrics using Phenolic-Formaldehyde Resins and Diazonium Salts, Part I: A Preliminary Investigation (October 1976)

No. 327 : Hunter, L., Cawood, M. P. and Dobson, D. A., The Relationship between Yarn Properties and Knitting Performance for Cotton Yarns Knitted to a Constant Stitch Length on Single and Double Jersey Machines (October 1976).

No. 328 : Hunter, L., Aldrich, De V. and Andrews, G., A Comparison of Open-End and Ring Spinning of Cotton, Part I: The Physical Properties of 25 Tex Yarns Spun from Different Cottons Grown in Southern Africa (November 1976).

No 329 : Barkhuysen, F. A., Liquid Ammonia Mercerisation of Cotton, Part VI: Liquid Ammonia Treatment of 50/50 Cotton/Polyester Fabrics (November 1976).

No 330 : Turpie, D W. F., Unconventional Scouring, Part IX: The Effect of Added Clay on Scouring Efficiency (November 1976).

No. 331 : Weideman, E., Gee, E. and Van Rensburg, N J. J., Studies on the Surface Chemistry of Wool, Part II: The Critical Surface Tension of Wool and Polymers -- Some Results and a Reinterpretation of the Theory on Surface Interactions (November 1976).

No. 332 : Van Rensburg, N. J. J., The SAWTRI Simultaneous Shrink-Resist and Flame-Retardant Treatment for All-Wool Fabrics, Part I: Preliminary

Trials with Chlorine-Hercosett/THPOH and Chlorine/THPOH (December 1976).

No. 333 : Hunter, L. and Gee, E., The Between-bale and Between-lot Variation of South African grown Cottons, Part II: Bundle Tenacity and Extension at 3,2 mm ($\frac{1}{8}''$) gauge (December 1976).

No. 334 : Robinson, G. A. and Green, M. V., Cockling in Fully-Fashioned Knitwear, Part II: An Investigation into the Effect of Various Fibre, Yarn and Fabric Properties on Cockling (December 1976).

TEXTILE ABSTRACTS

A Simple Device for Assessing Wrinkle Performance of Fabrics by Stress Relaxation in Bending, by B. M Chapman, *Text. Res. J.*, **46**, 525 (July 1976).

A description is given of a very interesting instrument which has been developed and which characterises fabric wrinkling in terms of two fundamental parameters viz. its visco-elastic and frictional components The instrument represents a significant advance towards the understanding of the wrinkling behaviour of fabrics and the way this is changed by variations in fibre composition, finishing treatment and fabric structure and it should prove useful for both analytical and routine assessment of the wrinkling behaviour of fabrics.
(L.H.)

Pilling of Textile Fabrics, by K. S. Shama Rao and G. R Phalgumani, *Textile Highlights* 31 (April 1976)

This paper discusses the mechanism of pilling and ways of reducing pilling. Concerning the latter it is stated that pilling may be reduced by, amongst other things, reducing yarn hairiness and increasing the inter-fibre frictional forces. In practice, increasing the yarn twist, number of doublings, fabric cover factor and fibre length should reduce pilling tendency. Fabric singeing and thermosetting also reduce pilling
(L. H.)

Factors Affecting the Performance of Heavy Weft-Knit Fabrics, by J. A. Iredale and I. Samadi, *Knitting World*, **76** (5), 20 (1976).

The effect of fibre quality (fineness) and yarn and fabric structure on the abrasion resistance, snagging propensity and shrinkage of knitted wool fabrics was investigated. The wool qualities studied were 58's super, 56's and 52's. It was concluded that, within the ranges covered, wool quality had a greater effect on the three fabric properties than either yarn or fabric structure. Abrasion and snagging resistances were better when feeding multiple ends than when using a coarser singles yarn. Increasing fabric cover factor improved resistance to both abrasion and snagging.

After considering the evidence produced at all the stages of the work, it was concluded that 52's quality untreated wool, spun to R111 tex/2 (2/16's worsted count) and knitted into a 2 x 2 rib structure was suitable as an outerwear fabric.
(L.H.)

Opening, Picking and Drawframe Blending Techniques on Textile Products, by G. L. Louis and L. A. Fiori, *America's Textiles Reporter/Bulletin*, **AT-5**, No 5, 53 (May, 1976).

This paper reports on the evaluation of mechanical processing variables and blending techniques to produce high quality sliver, roving, yarn and fabric from

TABLE I

FIBRE PROPERTIES

Cultivar	Micro-naire	Maturity Ratio	Fineness (mtex)	2,5 % Span Length (mm)	1/8"-Gauge Tenacity (cN/tex)	Percentage Extension
Alma C535/311/2/1	4,8	0,95	194	27,3	20,3	8,2
Del Cerro	3,8	0,84	155	30,6	32,5	6,9
CS2	4,3	0,81	176	26,9	19,7	6,3
Acala SJ 185	4,7	0,92	185	29,2	30,0	6,2
Alma 76	3,7	0,80	170	24,8	18,6	8,9
Deltapine 5826 Dirk	4,4	0,80	188	27,4	26,4	5,6
Albar 10217	4,7	0,78	191	27,7	21,4	6,1
Acala 1517/70	3,6	0,85	158	25,6	27,5	7,0
Deltapine 5826 Deal	4,2	0,87	179	25,3	22,1	7,8
Acala SJ 1	4,0	0,84	175	29,2	28,4	7,3
BSG 31878	3,9	0,75	173	25,8	27,2	7,1
Deltapine 5826 BSG	4,3	0,83	184	28,6	25,6	7,1
Acala SJ 141	5,0	0,93	198	29,5	27,2	7,4
Albar 736	4,9	0,88	187	26,5	23,4	7,6
Deltapine SL	5,2	0,89		26,5	22,6	8,1

passages were used on the drawframe and one passage on the speedframe (see Table III).

Spinning

Open-end yarns of 30 tex were spun on a Rieter Rotondo using a nominal metric twist factor of 48 (English cotton twist factor = 5). Ring yarns of 30 tex were spun using a nominal twist factor of 38 (English cotton twist factor = 4). (See Tables IV and V for processing details.) These yarns were tested for breaking strength, irregularity, thick and thin places, etc., in the usual manner.

Tables VI and VII summarise the properties of the OE and ring-spun yarns respectively, whereas Table VIII gives a comparison of the most important properties as well as the Uster average values.

TABLE II
PROCESSING DETAILS FOR OE SPINNING UP TO DRAWFRAME*

Cultivar	Card		Drawframe			
	Sliver Mass (ktex)	Waste %	Sliver Mass after 1st Pass (ktex)	CV % for Irregularity	Sliver Mass after 2nd Pass (ktex)	CV % for Irregularity
Alma C535/311/2/1	3,9	2,91	4,0	4,2	3,8	4,3
Acala SJ 1	3,3	1,69	3,3	4,5	3,5	4,0
Acala 1517/70	3,4	2,27	3,8	4,0	3,8	4,6
Acala SJ 185	3,7	1,77	3,5	3,65	3,6	4,1
Acala SJ 141	3,7	1,78	3,6	3,2	3,7	3,4
Albar 736	4,2	2,24	4,2	5,2	4,1	4,6
Alma 76	3,9	2,47	3,9	4,6	4,1	4,9
Deltapine 5826 Dirk	3,9	1,72	4,1	4,0	4,1	3,7
CS2	3,7	2,44	3,8	3,8	3,7	4,3
Deltapine SL	3,8	1,94	4,1	4,0	4,2	4,2
Del Cerro	3,9	1,48	3,8	3,6	4,0	3,8
Albar 10217	3,8	1,93	3,7	4,1	3,8	5,1
Deltapine 5826 Deal	4,2	2,16	4,1	4,9	4,4	5,1
Deltapine 4826 BSG	4,1	4,27	4,1	4,4	4,1	3,7
BSG 31878	3,5	5,88	3,7	4,6	3,7	4,9

*The roller settings were 34–37 mm and the number of doublings 6 for the first pass.

TABLE III
PROCESSING DETAILS FOR RING-SPUN YARNS UP TO SPEEDFRAME*
(Average values for all 15 cottons)

Drawframe				Speedframe			
Sliver Mass 1st Pass (ktex)	CV %	Sliver Mass 2nd Pass (ktex)	CV %	Feed Sliver Mass (ktex)	Delivery tex	CV %	Total Draft
3,9	3,1	3,9	3,4	3,9	420	6,2	9,2

*The roller settings were 34–37 mm and the number of doublings 6 for the first pass on the Drawframe.

TABLE IV

SPINNING DETAILS FOR 30 TEX OPEN-END YARNS AT A ROTOR SPEED OF 45 000 R/MIN AND OPENING ROLLER SPEED OF 6 000 R/MIN

Cultivar	Feed Sliver Mass (ktex)	Total Draft	Delivery Speed (m/min)	t.p.m	Trash Taken Out by Opening Roller (g/kg Yarn Spun)
Alma C535/311/2/1	3,8	125,3	51.5	874	1,17
Acala SJ 1	3,5	116,6	”	”	0,69
Acala 1517/70	3,78	126,0	”	”	1,75
Acala SJ 141	3,71	123,6	”	”	0,59
Albar 736	4,05	135,0	”	”	1,90
Alma 76	4,12	137,3	”	”	1,50
Deltapine 5826 Dirk	4,12	137,3	”	”	0,50
CS2	3,73	124,3	”	”	1,20
Deltapine SL	4,16	138,6	”	”	0,70
Del Cerro	3,97	132,3	”	”	0,67
Albar 10217	3,78	126,0	”	”	0,91
Deltapine 5826 Deal	4,4	146,6	”	”	0,67
Deltapine 5826 BSG	4,17	139,0	”	”	0,57
BSG 31878	3,72	124,0	”	”	0,60
Acala SJ 185	3,61	120,3	”	”	0,42

TABLE V

SPINNING DETAILS FOR 30 TEX RING-SPUN YARNS AT A SPINDLE SPEED OF 11 000 R/MIN AND TRAVELLER SPEED OF 29,2 M/S

(Average values for all 15 cottons)

Roving tex	Total Draft	Front Roller Speed (r/min)	t.p.m.
430	13,9	195	699

TABLE VI

PROPERTIES OF 30 TEX OPEN-END YARNS

Cultivar	Breaking Strength (cN)	CV %	Exten-sion%	CV %	Irregu-larity CV %	Thin Places per 1000 m	Thick Places per 1000 m	Neps per 1000 m	Twist (t.p.m)	
									Mean	CV %
Alma C535/311/2/1	288,1	13,9	9,2	10,0	15,2	6	35	535	796	4,8
Del Cerro	369,3	7,6	8,0	7,0	14,2	3	22	361	746	2,7
CS2	285,2	6,4	7,9	7,6	15,3	7	15	530	793	2,7
Acala SJ 185	325,8	10,2	7,6	8,4	15,1	5	3	307	774	3,8
Alma 76	258,7	7,3	10,5	8,0	15,6	5	32	523	783	4,0
Deltapine 5826 Dirk	298,7	7,3	9,4	7,7	15,5	6	23	363	781	3,5
Albar 10217	302,8	8,1	8,1	7,9	16,3	15	26	558	796	4,0
Acala 1517/70	292,2	8,4	8,1	9,9	15,0	0	27	403	771	2,6
Deltapine 5826 Deal	311,1	8,7	8,0	8,5	15,9	6	28	369	821	4,4
Acala SJ 1	325,2	8,1	7,2	9,7	15,3	6	26	293	798	3,5
BSG 31878	242,3	15,1	7,1	13,8	15,0	4	23	485	844	5,6
Deltapine 5826 BSG	285,8	8,0	7,7	11,2	15,7	10	44	667	806	2,5
Acala SJ 141	332,8	7,4	7,1	16,6	15,1	5	32	413	778	3,2
Albar 736	260,5	15,0	7,7	10,1	16,0	20	33	580	826	3,1
Deltapine SL	275,2	7,8	8,1	7,9	15,5	11	31	393	799	3,8
Average:	296,9	9,3	8,1	9,6	15,4	7,3	27	452	794	3,6

TABLE VII

PROPERTIES OF 30 TEX RING-SPUN YARNS

Cultivar	Breaking Strength (cN)	CV %	Exten-sion %	CV %	Irregu-larity CV %	Thin Places per 1000 m	Thick Places per 1000 m	Neps per 1000 m	Twist (t.p.m)	
									Mean	CV %
BSG 31878	349,9	10,1	4,9	18,0	18,4	37	362	554	697	3,3
Deltapine 5826 BSG	424.5	9,0	5,7	12,0	18,2	56	399	437	689	4,5
Albar 10217	446,9	9,7	6,0	10.7	16,5	11	289	376	696	2,3
Deltapine 5826 Deal	475,3	13,0	6,8	15,4	16,3	11	165	166	711	3,0
Del Cerro	574,8	8,6	5,8	10,5	18,4	114	482	199	719	5,2
Deltapine 5826 Dirk	484,1	6,5	7,5	7,5	17,0	11	465	412	697	5,0
Deltapine SL	399,3	11,3	6,3	10,8	17,2	25	216	160	708	4,6
				Av. 12,1		Average 38	Average 340		Average 702	Average 4,0
Alma 76	336,0	7,6	7,6		16,1			307		
Albar 736	405,9	8,8	6,4		16,1			224		
Acala SJ 185	522,0	7,3	6,5		15,2			90		
Acala SJ-1	504,0	8,2	6,7		15,1			130		
Alma 535/311/2/1	381,0	8,8	7,5		16,3			360		
Acala 1517/70	480,0	7,3	7,0		15,4			353		
CS2	411,0	8,4	7,0		16,1			376		
Acala SJ 141	510,0	7,6	7,1		15,1			93		
Average:	447,0	8,8	6,6		16,5			283		

TABLE VIII

COMPARISON OF RING AND OE YARNS

Property	Ring-Spun	Open-End Yarns	Uster Average Values	
			Ring	OE (Prov.)
Yarn tenacity (cN/tex)	14,9	9,9	12,2	–
Yarn breaking strength				
(cN)	447	296,9		
CV %	8,8	9,3		
% Extension	6,6	8,1	7	–
CV %	12,1*	9,6		
Irregularity (CV %)	16,5	15,4	18,1	15,3
Thin places/1000 m	38*	7,3	45	15
Thick places/1000 m	340*	27	330	43
Neps/1000 m	283	452	300	200
Twist (t.p.m)	702*	794	–	–
CV %	4,0*	3,6	–	–

*For seven cottons only.

RESULTS AND DISCUSSION

By considering the comparison (see Table VIII) of the resultant 30 tex yarns the following observations can be made:

1. On average the ring-spun yarns are stronger by 33 *per cent*. This is not unexpected as the metric twist factor for the ring-spun yarns was 38 (which is normal) but that of the OE yarns was only 43,7. Ideally, the twist factor for OE yarns should be about 25 *per cent* higher (i.e. 47,5) than that of ring-spun yarns. Obviously some fibre slippage must have taken place inside the rotor as the theoretical calculations were aimed at the latter twist factor.
2. The OE yarns are more extensible which is in line with observations made elsewhere[1].
3. The OE yarns are more regular which, once again, is in line with current thinking.
4. The OE yarns have less thick and thin places[1].
5. The number of neps was higher for OE yarns, which is not common This parameter, however, can be influenced by many factors.
6. If one plots the fibre tenacity against the resultant yarn strength (see Fig. 1), the interesting observation is made that for relatively weak fibres the dif-

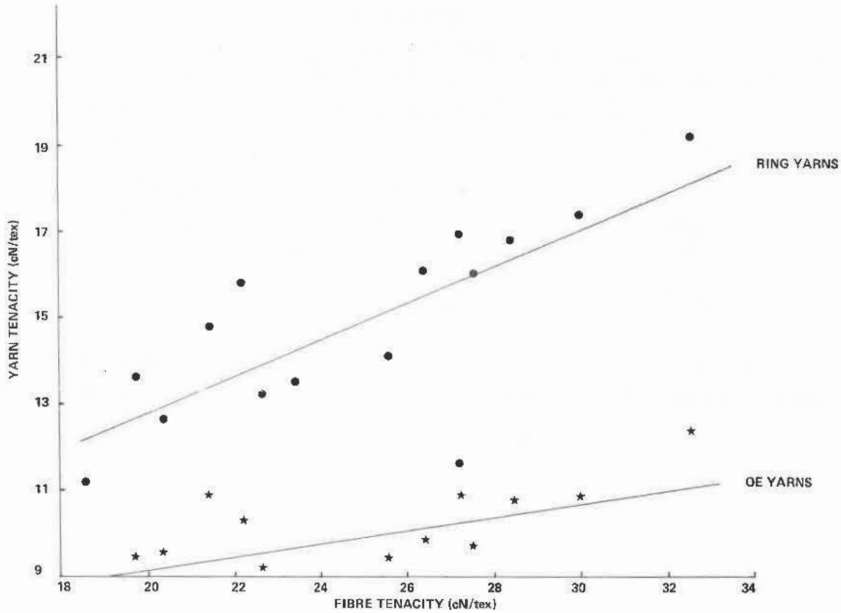

RING YARNS
OE YARNS
YARN TENACITY (cN/tex)
FIBRE TENACITY (cN/tex)
9
11
13
15
17
19
21
18
20
22
24
26
28
30
32
34

FIGURE 1

ference in resultant yarn strength between OE and ring yarns is much smaller than for strong fibres. This implies that for OE spinning, relatively greater benefits are derived from the use of weaker fibres as raw material.

The statistical relationship between yarn tenacity *(y)* and fibre tenacity *(x)* for OE yarns is as follows:

$y = 0{,}146x + 6{,}29$ (significant at the 95 *per cent* level, n = 15)

and for ring-spun yarns:

$y = 0{,}417x + 4{,}50$ (significant at the 99 *per cent* level, n = 15)

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SOME COMMENTS ON THE USE OF CRITICAL DISSOLUTION TIME (CDT) AND IODINE SORPTION – TWO METHODS FOR DETERMINING THE THERMAL HISTORY OF POLYESTER YARNS

by F. HAIBER

ABSTRACT

Different commercially produced polyester yarns were studied using the Critical Dissolution Time (CDT) and the iodine sorption test methods. Since they are quick and easy to perform these tests should be useful as quality control measures for textured polyester yarns. However, for reproducible results it is necessary to select carefully the testing conditions for these two methods. This aspect is elaborated upon in this report. The theoretical background and a discussion of the two methods are also given.

INTRODUCTION

The properties of fibres depend not only on their chemical constitution, but also to a large extent on the physical structure of the fibres. The physical structure of synthetic fibres, such as polyester, can change during processing if the processing temperature is higher than the glass-transition temperature of the fibre-forming polymer. The main stages where this can occur is during drawing, texturing, annealing, dyeing and heat-setting.

The physical structure of a fibre is determined by the degree of crystallinity and the orientation of the crystalline and amorphous parts in the fibre. To determine both the degree of crystallinity and the orientation, sophisticated methods such as the use of X-ray equipment or polarising microscopes are employed. However, with the determination of certain fibre properties an indirect evaluation of the effect of various heat treatments on the physical structure may be obtained. A survey on the different methods is given by Schauler and Liska[1]. From the large number of properties which depend on the physical structure of polyester, the solubility of the yarn in certain solvents and the iodine-sorption characteristics were selected in order to ascertain whether these measurements would be useful as a quality control procedure.

IODINE SORPTION TEST

Theory

This method is based on the diffusion of iodine through the fibre and the Van der Waals forces between fibre and iodine. Since diffusion occurs only in the amorphous regions, a high iodine sorption value indicates a low degree of crystallinity. There are, however, two important parameters to be considered in the iodine sorption test, namely the time and temperature at which the sorption takes place. An increase in temperature increases the rate of diffusion but decreases Van der Waals forces[2]. The iodine sorption isotherms of a selected yarn are shown in Figure 1. The iodine sorption values of different yarns can only be compared at the state of equilibrium, i.e. when the differential of the isotherms is zero.

CRITICAL DISSOLUTION TIME (CDT)

Theory

The dissolution of polymers can be described by means of the Gibbs-Helmholtz-equation, namely:

$$\Delta G = \Delta H - T\Delta S .$$

Dissolution takes place only if ΔG is negative. The term ΔS is always positive. When ΔH is positive, there must be an equilibrium at a certain temperature, where $\Delta H = T\Delta S$ and $\Delta G = 0$. When ΔH is negative, solid and solvent can be admixed in any proportion. This is the case with polyester and phenol. Since a more crystalline region in a polyester yarn has a higher degree of molecular orientation than a less crystalline (more amorphous) region, it has a higher ΔS value and beyond a certain temperature the more crystalline polyester, therefore, must have a lower CDT value than the less crystalline polyester. Gacen[5,6] found a linear relationship between log CDT and the temperature at dissolution. The straight lines representing two different polyesters intersected at about 72°C. Usually the CDT test is carried out at lower temperatures, because the differences between different yarns increase with a decrease in the temperature. However, with pure phenol the lowest temperature at which the test can be carried out is 41°C, which is the melting point of phenol. For less crystalline polyesters Galil[7] used a mixture of phenol and tetrachloroethane, which can be used at lower temperatures. On the other hand, when the CDT test is carried out at 45°C in pure phenol, the time required for dissolution of more crystalline polyester may be more than 30 minutes, which is not always practical.

EXPERIMENTAL

Raw Material:

Commercial textured polyester filament yarns with differences in linear density, drawing-ratio, texturing and dyeing were used.

Iodine Method:

(a) **Solutions:**

Iodine solution (1 N):

This was prepared by dissolving 127 g iodine and 200 g potassium iodide in water. To this solution were added 100 mℓ glacial acetic acid and 350 mℓ molten phenol measured at 60°C, finally made up to 1 ℓ with distilled water.

Methylene chloride/phenol solution: This solution was prepared in a 1:1 ratio (by mass).

Sodium Thiosulphate solution (0,1 N): Prepared in the usual manner.

(b) **Test Procedure:**

Except for a few details, the method is based on the technique proposed by J. Gacen, J. Maillo and J. Border[3]. Fifty mℓ of the iodine solution is placed in pyrex tubes (25 x 200 mm) and heated to the temperature at which the sorption test is to be carried out. Into each tube is placed one sample (approximately 0,5 g, accurately weighed) of fibre and this is kept in contact with the iodine solution for a predetermined time. After the completion of the test the sample is removed and washed in distilled water until the rinse water appears completely colourless. The sample is then dissolved in 30 mℓ of a boiling phenol/methylene chloride mixture in an Erlenmeyer flask. After cooling, 10 mℓ of distilled water and 3 g potassium iodide are added and the iodine is determined by titrating against a 0,1 N thiosulphate solution.

The iodine sorption (IS) is expressed in mg of iodine sorbed per gram of fibre and is calculated as follows:

$$IS = \frac{V \times 0{,}1 \times 126{,}91}{W}$$

Where V = volume of thiosulphate used in the titration (mℓ), 126,91 is the equivalent weight of iodine and W is the mass of the sample (g).

CDT Test Method:

According to the methods of Gacen[6] and Galil[7] the polyester is placed under a tension of one gram in a pyrex tube (25 x 200 mm) containing molten phenol in a thermostat. The time lapse is recorded from the point of introduction of the yarn until the one gram mass drops down. At a temperature of 50°C this period varied from one to eight minutes with yarns drawn and textured under different conditions. This gives an indication of the sensitivity of the method.

RESULTS AND DISCUSSION

The isotherms of the iodine sorption (Figure 1) show that it is necessary to carry out the iodine sorption test under equilibrium conditions, for example at a temperature of 65°C with a sorption time of 30 minutes. Table I shows the IS of different yarns, tested under these conditions, as well as the CDT values of the same samples. With one exception the results follow the rule, namely that yarns with a high IS have a low CDT value. There is, however, as yet no formula to correlate the two parameters.

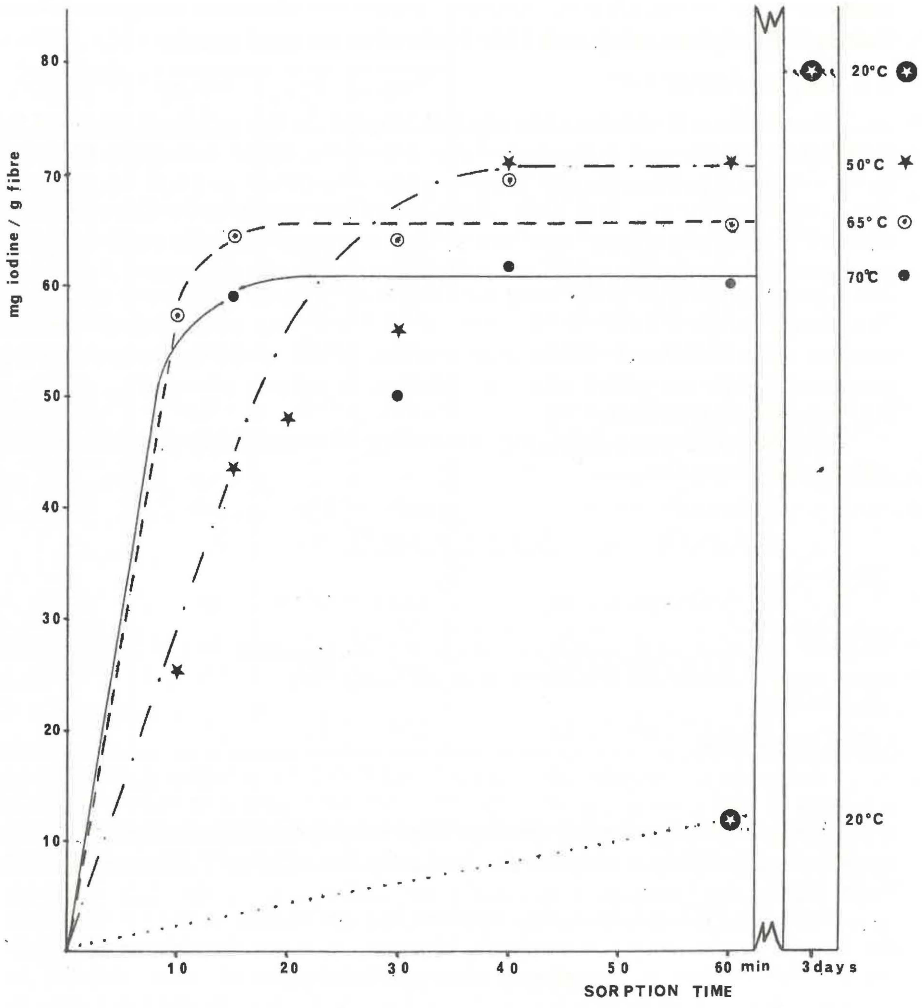

FIGURE 1

Isotherms of Iodine Sorption
1/50 f_{44} w_1 nat circular

TABLE I

Type of Yarn	CDT			IS mg Iodine/ g fibre
	Min. (s)	Max. (s)	Average (s)	
1/200 f60				
W_1 NAT CIRCULAR	156	167	161	43,48
1/167 f30				
W_1 NAT CIRCULAR	109	118	113	58,94
W_1 NAT TRILOBAL	194	218	203	48,50
W_1 DYED CIRCULAR	279	287	282	(47,72)
W_1 DYED TRILOBAL	183	190	187	52,16
W_2 NAT CIRCULAR	48	54	51	28,96
W_3 NAT CIRCULAR	61	65	63,5	51,10
W_3 NAT TRILOBAL	49,5	52	50,5	62,91
2/167 f30				
R/S NAT	140	153	148	55,92
R/S DYED	156	214	183	–
1/150 f44				
W_1 NAT CIRCULAR	140,5	152,5	148	64,05
1/85 f15				
W_1 NAT CIRCULAR	303	325	313	33,20
1/110 f30				
W_1 NAT CIRCULAR	239	247	243	54,44

When the results obtained on the undyed and dyed yarns of the same sample are compared (Table I), it can be seen that dyeing also affects the physical structure of the fibres.

Both the CDT and the iodine sorption test can be used to assist in evaluating the thermal history of different fibres. However, it is not possible to determine the absolute degree of crystallinity or orientation without some standard or reference fibres, i.e. these tests should be used as a basis for comparing two yarns or two portions of a fabric. Since both methods are very sensitive to changes in the testing conditions, tests should be carried out in the same thermostat. Furthermore, in the case of the iodine sorption, the operator should also not be changed during a series of tests. It may, however, not be possible to do the iodine sorption test on dyed samples, but it offers the following advantages: staple yarn as well as fabrics can be tested and the sorption mechanism is similar to the dyeing mechanism and therefore corresponds with the dyeability of the yarn. The CDT method offers the following advantages: it is a very quick and simple method, the same sample of phenol can be used for a large number of tests, the sample must have a length of only about 30 cm (which is about 10 mg), and dyed or undyed yarns can be used.

A Few Practical Examples:

A test on yarns removed from two fabrics with barré showed that in one case the barré corresponded with a region of lower crystallinity in the yarn The CDT decreased from seven minutes for the yarn unravelled from the normal fabric area to 1,5 minutes for the yarn unravelled from a "bar". This demonstrates that there were significant differences in physical structure between the two yarns.

In another fabric, however, no significant difference in CDT was found, and the barré observed was most likely due to variations in the knitting conditions.

These results are in agreement with tests carried out on an instrument developed by the National Physical Research Laboratory of the CSIR for measuring barré from variations in light reflectance[8].

Future Work:

The influence of oligomers, water, TiO_2, dyestuffs and finishing agents will be studied in further investigations. It may then also be possible to correlate the results obtained with these test methods with the results obtained from other methods.

Measurements will be taken at different stages of fibre production to supply more knowledge about the effect of various processing conditions on the physical structure of the fibre.

SUMMARY

The theoretical background of two methods (Iodine Sorption and Critical Dissolution Time) which are used for the study of the thermal history of polyester yarns has been described. The conditions under which the most reproducible results could be obtained were given. Both methods were found very sensitive to differences in the physical structure of the yarns. However, no absolute figures of crystallinity or orientation can be obtained by using these methods alone without reference to a fibre of known degree of crystallinity and orientation It was shown, however, that both methods are very useful in assisting determination of the possible causes of fabric barré.

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SOME STEPS TOWARDS AUTOMATION IN FRL AND AKU WRINKLE RECOVERY MEASUREMENTS

by I. W. KELLY

Wrinkle recovery tests can be divided into (a) objective methods, where a crease is inserted parallel to the warp or weft threads of the fabric and the angle of the crease remaining after a period of recovery measured by a protractor, and (b) subjective methods, where a random or ordered arrangement of creases are inserted in the specimen and the severity of the wrinkling assessed subjectively by comparing the wrinkled sample with standards. Because it is believed that those wrinkle recovery tests which employ a random or an ordered arrangement of creases, for example the FRL and AKU methods of creasing, reproduce more closely the conditions prevailing during wear, these tests are often preferred. It is well known, however, that a bold pattern on the fabric can markedly influence an observer's assessment of the wrinkling of a fabric. For this reason Slinger[1] and workers elsewhere[2] attempted to quantify the severity of wrinkling objectively in terms of the wrinkled profile of the fabric after a certain recovery period.

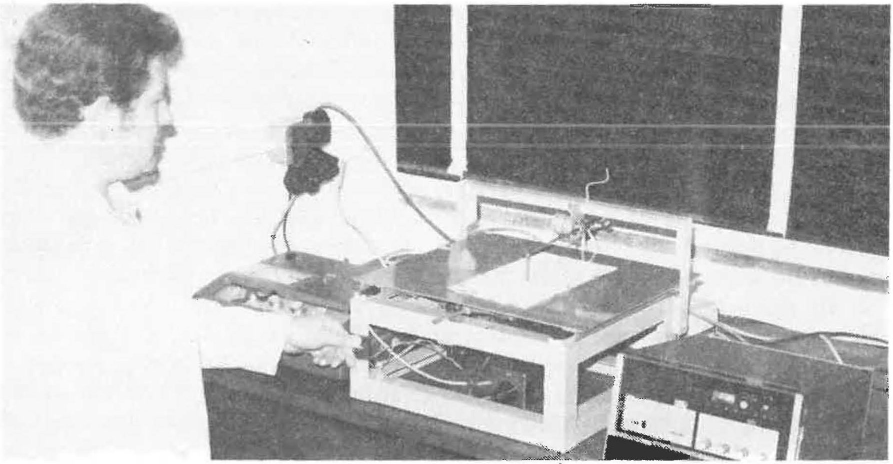
In the method developed by Slinger[1] a stylus, lever and counter-balance were attached to a load cell by a spring so that the height of the fabric above the table was proportional to the load acting on the load cell. As the fabric, on a motor driven table, moved underneath the stylus so an enlarged profile of a section of the fabric was displayed on a chart recorder. The root mean square of the displacement of the stylus about its mean position, called the wrinkle height, was calculated by reading values from the graph.

This is, however, a laborious procedure and attempts have been made at SAWTRI to expedite matters, particularly in the evaluation of the trace obtained for the fabric profile.

The first modification was to eliminate reading of the graphs by the operator. This was achieved by feeding the output from the load cell, via a DC output module on an Instron tensile testing machine, to a digital voltmeter and then through an interface to a Wang 600 programmable calculator so as to enable the "on-line" calculation of the wrinkle height.

More recently the load cell and lever assembly has been replaced by a rotary variable differential transformer (RVDT) thus obviating the need to use the Instron testing machine. In the present method a counterbalanced stylus pivots about the axis of the RVDT, which gives a DC output proportional to the angular displacement of the shaft. For the range of angular displacements encountered in practice, the difference between the angular displacement and its sine function which ideally should be measured, is less than 1 *per cent* and is ignored. The output from the RVDT is fed into an off-set amplifier after which it is stored on magnetic tape for later processing or else it is fed directly to a digital voltmeter connected to a calculator, which, once again, allows the wrinkle height to be computed automatically When the information is stored on magnetic tape by an instrumentation cassette recorder it can be replayed to the digital voltmeter and programmable calculator at 10 times the recording speed. The agreement between the graphical method of measuring the wrinkle height and automated method was found to be very good.

A photograph of the stylus, RVDT, sample table and recorder is shown below.



From left to right the differential transformer, and sample table with the stylus tracing a fabric profile, and the magnetic tape cassette recorder

ACKNOWLEDGEMENT

The author wishes to thank Mr E. Gee for programming the computer

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IRREGULARITY AND TENSILE PROPERTIES OF SOME COMMERCIAL WOOL/POLYESTER YARNS

by L. HUNTER and G. ANDREWS

ABSTRACT

The tensile properties and irregularity of 90 commercial wool/polyester yarns (40% wool/60% polyester to 60% wool/40% polyester) have been determined and are presented graphically. These graphs can be used in practice for reference purposes i.e. by a quality control laboratory for determining how a particular wool/polyester yarn compares with other yarns having a similar linear density and composition.

INTRODUCTION

A question which frequently arises in quality control and research laboratories is how does a particular textile product, be it fibre, yarn or fabric, compare with other similar items on the market in so far as one or more physical properties are concerned. To answer such a question it is necessary to determine the physical properties of a representative cross-section of such items and also to determine how these properties are affected by those variables which may change in practice. Over the past few years SAWTRI has undertaken a number of projects directed towards establishing "reference" levels or "average" values for various yarn and fabric properties which would allow a particular yarn or fabric to be "rated" or "assessed" according to other similar products on the market.

Further to this end, an investigation was carried out at SAWTRI directed towards wool/polyester yarns, since the only information which appears to be available for these yarns is that contained in a publication by Messrs Zellweger (Uster) Ltd[1] and which only deals with the evenness properties of the yarns. In the present study, therefore, the tensile properties and irregularity of a range of commercial wool/polyester yarns have been measured and related to the yarn linear density.

EXPERIMENTAL

In all, 90 wool/polyester yarns have been covered in this study. The lot comprised dyed and undyed yarns in singles, two-ply and three-ply form. The distribution of the yarns will become evident later. The majority of the yarns consisted of 45% wool/55% polyester with the wool being of 64's quality (average fibre diameter was 21,5μm) while the polyester generally had a linear density of 3,6 dtex (mean fibre diameter 18 μm). The variation about the above values was extremely limited and was disregarded.

The yarn tensile properties were measured on an Uster Automatic Single Thread Tester, at least 100 tests being carried out per yarn sample, while the yarn irregularity was measured on the Uster range of evenness testing equipment, approximately 1 000 metres of yarn being tested per sample. All tests were carried out at 20 ± 2°C and 65 ± 2 *per cent* RH.

RESULTS AND DISCUSSION

Although it was initially intended to separate the yarns according to blend level, as determined on the projection microscope, it was found that the percentage composition so determined had no apparent effect on the observed results. It was therefore decided to ignore blend level, although it must be emphasized that the results obtained here for breaking strength (and tenacity) will not hold for either very high or very low levels of wool. They are, however, considered to apply to wool levels of between about 40 and 60 *per cent.*

In Figure 1 yarn breaking strength in centinewtons (cN where 1cN = 1,02 gf) has been plotted against yarn linear density while in Figure 2 the results have been converted to tenacity (cN/tex) and plotted against linear density. A regression analysis was carried out on the results plotted in Figure 1 (in their log form) and the following regression equation was obtained:

Breaking strength (in cN) = 8 (Resultant linear density)^{1,18} . . . . (1)

Number of readings = 86; correlation coefficient = 0,93.

This regression curve has been superimposed onto the results plotted in Fig. 1.

From Figure 2 it is apparent that the tenacities of the *undyed* yarns generally lie between about 15 and 20 cN/tex while those for the *dyed* yarns lie between about 10 and 15 cN/tex. The results plotted in Figures 1 and 2 can therefore be used in practice as a guide to the values which may be expected for wool/polyester yarns having linear densities and blend levels similar to those of the yarns covered here. The tenacities of the two-ply yarns tended to be higher than those of the single yarns, which is not unexpected. No allowance has been made for variations in either singles or plying twist.

In Figure 3, yarn extension at break has been plotted against yarn linear density. It is apparent that there is a trend for extension to increase with an increase in yarn linear density although no pronounced or consistent effect of dyeing or plying is evident.

In Figure 4 yarn irregularity (CV in %) has been plotted against yarn linear density with the Uster 50 *per cent* (i.e. "average") line (solid) superimposed. No distinction between dyed and undyed yarns was considered necessary in this case. For this graph it is important to remember that the wool fibre diameter and polyester fibre linear density were reasonably consistent at 21,5 μm and 3,6 dtex, respectively. The well-known effect of yarn linear density is evident and it is also

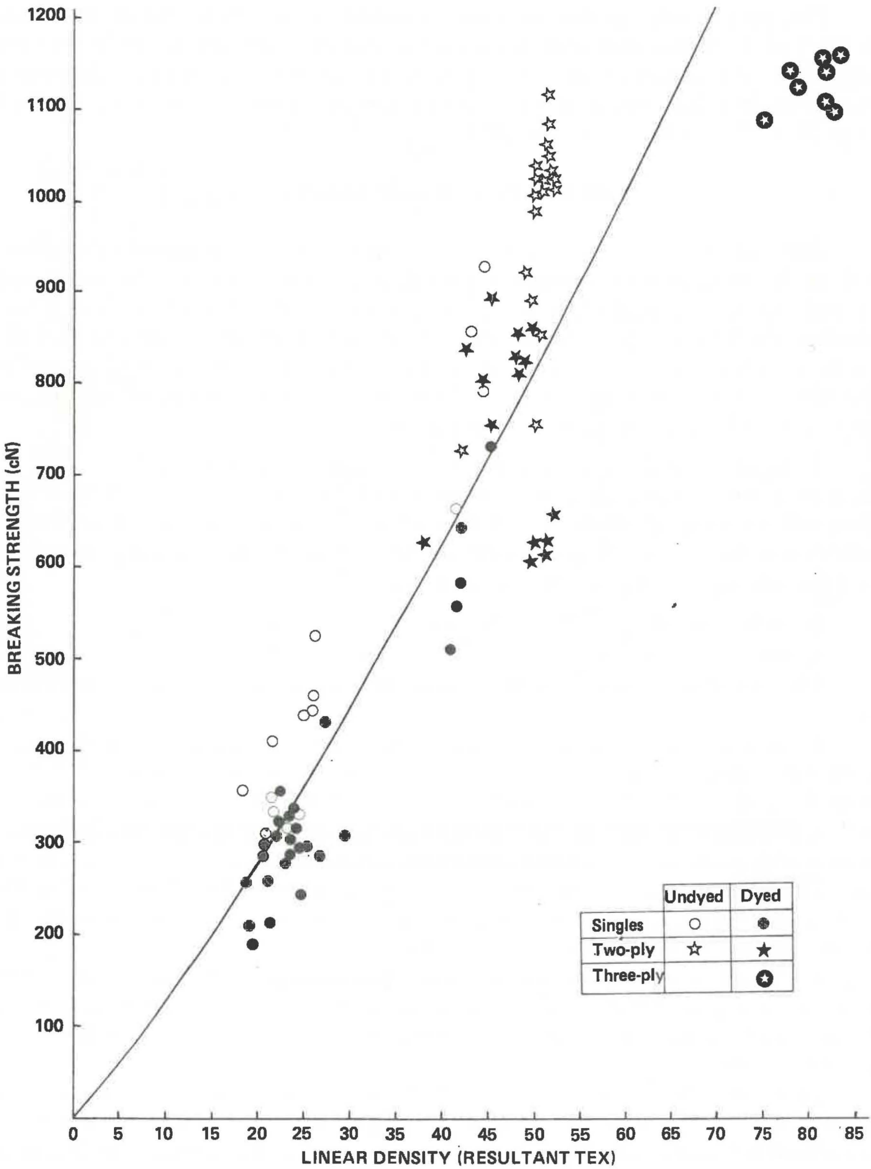

FIGURE 1

Yarn breaking strength vs yarn linear density

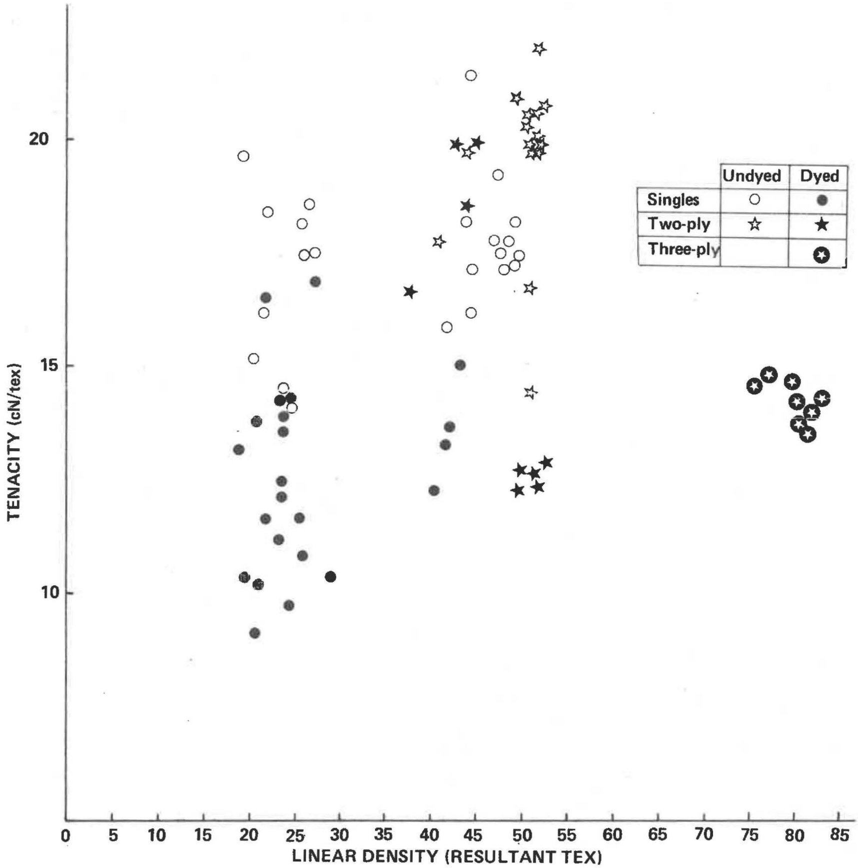

FIGURE 2
Yarn tenacity vs yarn linear density

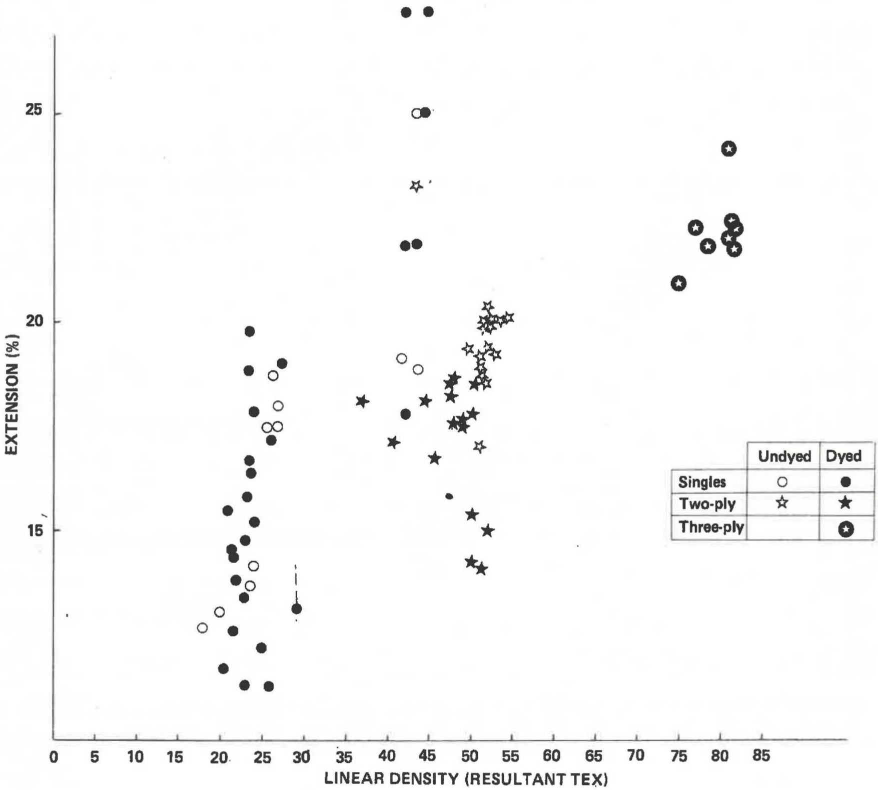

FIGURE 3

Yarn extension at break vs yarn linear density

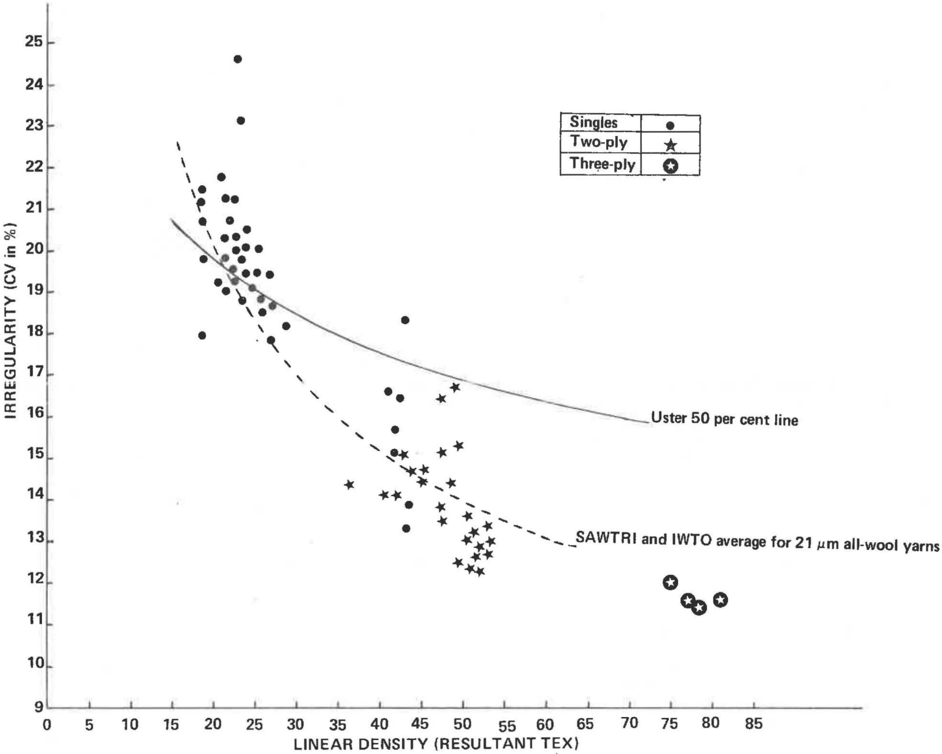

FIGURE 4

Yarn irregularity vs yarn linear density

apparent that, at the lower yarn linear densities, the agreement between the values obtained here and the Uster average (50 *per cent*) line is good but for coarser yarns the discrepancy becomes progressively worse. It is surmised that the relatively coarse yarns tested by Uster were spun from relatively coarse fibres hence the higher average (50% experience) values observed by them.

The broken line drawn in Figure 4 can be considered reasonably representative of the average values obtained previously by both SAWTRI[2] and the IWTO[3] for *pure wool* yarns spun from 21 μm wool. This line fits the points fairly well indicating that the values obtained for all wool yarns may apply to wool/polyester yarns as well, provided the number of fibres in the yarn cross-section is similar.

SUMMARY AND CONCLUSIONS

The irregularity and tensile properties of 90 commercial wool/polyester yarns (comprising dyed and undyed singles, two-ply and three-ply yarns) have been determined and have been plotted against the yarn linear density. The yarns generally consisted of 21,5 μm (i.e. 64's quality) wool and 3,6 dtex polyester with the blend level being between about 40% wool/60% polyester and 60% wool/40% polyester. The values obtained can therefore be taken as fairly typical for yarns having the above compositions.

The various graphs can be used in practice as a guide to the tensile and irregularity values for commercial wool/polyester yarns.

The tenacity of the undyed wool/polyester yarns varied from approximately 15 to 20 cN/tex whereas those for the dyed yarns varied from approximately 10 to 15 cN/tex. No account was taken of variations in either singles or plying twist. The undyed two-ply yarn tended to be stronger than their singles counterparts which was not unexpected.

The average irregularity of the yarns agreed fairly well with the IWTO and SAWTRI average values for all-wool yarns spun from 21,0 μm fibres.

Finally, it may be concluded that the results shown graphically in this report may be used for reference purposes when evaluating the tensile and irregularity properties of wool/polyester yarns comprising between about 40 and 60 *per cent* wool and spun from 64's quality (about 21,5 μm) wool and about 3,6 dtex polyester.

In due course this work will be extended to cover a wider range of wool/polyester yarns as well as other blends.

ACKNOWLEDGEMENTS

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