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SAWTRI BULLETIN

SOUTH AFRICAN
WOOL AND TEXTILE RESEARCH INSTITUTE
OF THE CSIR

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Telex: 24-3203
Telephone: 532-131

P.O. Box 1124
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SYMPOSIUM ON NEW TECHNOLOGIES FOR TEXTILES

21 — 23 July, 1986 : Port Elizabeth

In pursuance of its policy to maintain a transfer of technical and specialised information to the South African textile industry, SAWTRI, in collaboration with the Eastern Cape Section of the Textile Institute, presented the Second Quadrennial Symposium under the auspices of the South African Advisory Committee to the Textile Institute with the theme of "New Technologies for Textiles".

The Symposium, which took place at the University of Port Elizabeth, attracted over 300 delegates and speakers from some ten overseas countries as well as from several of South Africa's neighbouring states, and it afforded those present with the opportunity to gain first hand knowledge regarding new developments and technologies, to renew old friendships, make new ones and to exchange views and ideas relating to textile technology. A similar Symposium, dealing with cotton only, was staged at the same venue in 1982, but this year the theme was broadened to include several fibre types in order to cater for a much wider section of the textile industry than before.

Fifty papers, of which seven were read by SAWTRI staff, were presented in the technical programme which included topics ranging from management and marketing to new developments in mechanical and wet processing of textiles. A complete list of all the papers presented in the programme appears elsewhere in this issue of the Bulletin. Mr A Frame, Joint Managing Director of the Consolidated Frame Corporation, presented a review of the entire proceedings at the conclusion of the technical programme which has also been printed in full elsewhere in this issue.

The Chief Director of SAWTRI and Chairman of the Organising Committee, Dr D W F Turpie, welcomed guests of honour and delegates at the official opening ceremony which was performed by Dr C F Garbers, President of the Council for Scientific and Industrial Research. Mr R W Goodall, President of the Textile Institute, Manchester, acted as guest speaker during the opening plenary session and he also later presided over the Fifth Textile Institute Convocation in South Africa which took place at the conclusion of the technical programme on the first day.

A number of social functions were arranged for delegates, the highlight undoubtedly being a Banquet and Cabaret Fashion show organised by the Textile Federation and sponsored by Messrs Hoechst, South Africa (Pty) Ltd; S.A. Nylon Spinners (Pty) Ltd, the Mohair Board and the Cotton Board.

Judging by the acclaim received from delegates during and after this Symposium, there is little doubt that the next Symposium with the theme of "New Technologies" will once again generate a great deal of interest and support from the textile industry, and may well become a regular event on the South African textile calendar.

Dr J.H. Visser, Executive Director of the National Productivity Institute (far right), pictured in the company of Dr C.F. Garbers, President of the CSIR and Dr D.W.F. Turpie, Chief Director of SAWTRI.

Prof J.S. Parker, Texas Tech University, USA, who gave one of the plenary lectures on the second day, being thanked by Dr L. Hunter, Director of SAWTRI who acted as Session Chairman.

Captured in happy mood immediately after the conclusion of the Symposium are left to right: Mr N.J. Vogt, Secretary of the Organising Committee; Mr A. Frame, who read the final paper of the Symposium and Dr D.W.F. Turpie, Chairman of the Organising Committee.

Some of the key figures in the planning of the Symposium pictured on the final day. (Left to right): Mr N.J. Vogt; Dr L. Hunter; Mrs M. Beer; Mr G.A. Robinson; Mr E. Gee; Dr D.W.F. Turpie; Mrs M. de Klerk; Mr R.B. Stuart and Mr P. Horn.

Papers presented at the Symposium

1. Mr R W Goodall, Guest Speaker.
2. Mr P Wierks, Shorter Delivery Times: The Squeeze is On. (Plenary Lecture).
3. Dr J H Visser, Productivity & Technology — Key Issues to the Textile Industry's Future Strategy. (Plenary Lecture).
4. Mr D J Eastaugh, Developments in Melt Spinning Technology and their Effect on Yarn and Textile Properties.
5. Mr E P Motte, New and Future Technology on Textile Waste Processing and Re-cycling.
6. Mr R R D Holt, Fibre Protection during Dyeing.
7. Mr F Preysch, New Generation of Hamel Twisting Machines — The Art of Twisting without a Balloon.
8. Mr L Truetzschler and Mr F Leifeld, Continuous Material Flow Control — Progress in Spinning Preparation.
9. Mr G A Smith, Water in Textiles — RF Applications.
10. Mr D B Allibone, Latest Developments in Circular Knitting, Compound Needle Developments and Electronic Patterning.
11. Mr R W Castagno, Requirements for Spinning of Fine Counts on the OE System.
12. Mr K Donath, New Equipment for Washing After Printing of Woven and Knitted Goods.
13. Mr S Shlagman, The Rôle of Technology on Market Economics and Competitiveness. (Plenary Lecture).
14. Mr D B Glasser, The Rôle of Technology in a Changing Retail Environment. (Plenary Lecture).
15. Mr B Christen, Economical Analysis of the Three Insertion Systems: Projectile, Air, Rapier.
16. Dr L Hunter and Mr K W Sanderson, Short Fibre Content: Measurement and Effect on Cotton Processing and Yarn Properties.
17. Dr H Zimmermann, Developments in Flame Retardant Textiles for Interior Furnishings and Public Transport Textiles.
18. Mr E Honegger, Airjet Weaving and Applications.
19. Prof H W Krause, Experience with AL-Meter Fibre Length Test Method in Cotton Spinning.
20. Dr N J J van Rensburg, Dr F A Barkhuysen & Dr A P B Maasdorp, Recent Developments in Lustre Measurements and Radiofrequency Bleaching and Dyeing.
21. Mr D von Hoyer, Dr F Gehring, Mr E Wirth and Mr K Zeleney, Modern Electronics in Weaving — Making it Simpler and Easier.
22. Mr P Vandevoorde, Wrap-spinning of Carpet Yarns — A New Application of an Old Process.

23. Mr R C Naylor, Practical Experience of Computerisation in a Wet Processing Environment.
24. Prof J S Parker, Selecting Cotton by Instruments and Computers for Utilization in the Production of High Quality Yarns. (Plenary Lecture).
25. Mr G A Robinson, Dr L Hunter and Mr E Gee, Yarn Properties of Importance to Weaving and Knitting.
26. Mr E T Griffiths, Producing Plain and Fancy Yarns on a Hollow Spindle.
27 Dr G Lucchi, Jiggers and Overflows — Discontinuous Processing of Fabrics in Open-width and Rope Form.
28. Mr L Miller, Computer Graphics and The Textile Designer.
29. Dr J P van der Merwe, From Fibre to Wrapped Yarn in a Single Operation on a Woollen Card.
30. Mr E Schnoeckelborg, New Quality Trends in Wet Finishing.
31. Dr A P B Maasdorp and Dr N J J van Rensburg, New Instrumental Methods for Analysis in Textile Chemistry.
32. Mr P Ingham, Mr C E Gore and Mr C S P Lee, Wool Worsted Yarn Developments.
33. Mr H H Mueck, Continuous Dyeing of Tubular Fabric on the Tubocolor.
34. Dr H E Bille, Only After the Correct Chemical Pretreatment can Raw Cotton be Regarded as a True Cellulosic Fiber. (Plenary Lecture).
35. Dr H H Schicht, Actual Trends in Textile Air Engineering — New Developments in Air Conditioning, Pneumatic Waste Removal and Machinery Cleaning. (Plenary Lecture).
36. Mr M Roberts, Computer Integrated Manufacturing (CIM).
37. Mr K Douglas and Mr H Mueller, An Integrated Quality Concept for Spinning and Weaving, i.e. Every Chain is as Strong as Its Weakest Link.
38. Mr E S Bohrer, Progress in Discontinuous Wool Package and Loose Stock as well as Fabric Dyeing.
39. Dr N D Scott, Fabrics with a Future — Non-wovens.
40. Mr L Neuhaus, What is the Future Course of Short Staple Spinning? — Evolution or Revolution?
41. Prof H-H Wang, Dyeing of Nylon 6 Fiber with New Redox System.
42. Mr P Greaves and Mr W J Lyttle, Weight Control of Fibre in Dry Laid Non-wovens and Yarns.
43. Mr E O White, High Volume Instruments Measurement of Cotton Fibers.
44. Mr J R Muff, High Pressure Squeeze Sizing.
45. Mr M G Dickson, Geotextiles in Civil, Structural and Mining Engineering.
46. Dr D W F Turpie, Recent Developments in Machines and Instruments at SAWTRI.
47. Dr S Galuszynski, Objective Measurement of Seam Pucker.
48. Mr P M Coope and Mr G Hebblethwaite, Spiral Fabrics.
49. Mr R J Crompton, New Developments in Textile Testing Equipment.

compound latch needles where the action of opening and closing the pivoted latch is restricting further increase of machine speed and the number of yarn feeds. Leading Companies are now assessing this technology and it would appear that the compound needle has many advantages. It was interesting to note that he forecasts, that in order to obtain greater productivity without impairing fabric quality, knitting machines will, in future, be developed having considerably higher speeds rather than increasing the number of yarn feeds. Knitting men are also very excited about the developments of continuous dyeing of tubular knitted fabrics described by Mr Mueck. This development may be a major leap found in knitting technology.

Mr Castagno told us that spinning fine counts in the O.E. system does not start at the O.E. spinning machine. The correct fibre has to be used together with optimum preparation before spinning. It is obvious that the O.E. machines are now developing a whole new technology of their own and we are going to need a new generation of properly qualified personnel to run these sophisticated machines in the future. These technicians will have to know which rotors, rotor grooves, diameters and speeds to use in order to achieve and engineer the end product required.

Mr Glasser from Woolworths, who have done so much to stimulate the upward quality trend in SA Textiles, told us that at the retail or sharp end of our textile industry, the role of technology is also vital. He also took up the theme spelled out by the first speaker and called for faster response to fashion and the need to be cost competitive with consistent high quality. He felt that most businesses which failed to prosper do so because they do not deal effectively with change, tending to cling to yesterday's solutions. What the customer wants today, he told us, is more convenient shopping hours, in an enticing environment. He also made a very strong plea to enlarge the training and educational platform for the Textile Industry in order to meet future requirements.

As the Symposium progressed, the technological developments in various other yarn formation methods were described to us by Mr Vandevoorde, when he spoke about wrap spinning of carpet yarns and their advantages over equivalent ring spun yarns. Mr Griffiths described the production of plain and fancy yarns on hollow spindles.

Dr van der Merwe also presented a paper describing a very new unique method of yarn manufacture which eliminates the need for a separate spinning machine. By fitting hollow spindles to a woollen carding machine, he made a yarn in a single process. Wool enters the machine at one end and woollen spun wrap yarns emerge from the other. This is more exciting than appears at first glance!

The paper present by Mr Ingham then covered the whole spectrum of wool worsted yarn developments. What a pity the S.A. Worsted Textile

Mr Van Hoyer also discussed electronics and in particular the part played by the micro-processor in the design of textile machinery. Micro-processor controlled looms also make weaving simpler and easier. The key behind Mr Truetzschler's paper on "Continuous material flow control — progress in spinning preparation" was also micro-processor controlled, so that all machines may be co-ordinated into a continuous production system which can be controlled according to predetermined material demand thus eliminating operator error and improving reliability. How does this all relate to our markets?

Modern fast communications and travel have expanded large sections of our textile trade into an international trade. As Textile Companies vie for a competitive edge in this world market place, I seem to feel that the basic research and development trend in technology is moving more towards product innovation than machinery automation, although the latter trend is still strong. The most critical issue facing the Textile Industry is ensuring that its product, services and practices are appropriate for today's rapidly changing textile markets. We will have to take the initiative to identify our customers' changing needs and develop appropriate products and services — that is closer co-ordination between production, marketing and support functions.

The Textile Industry of the future will have to emerge leaner and meaner as it cannot survive as a service economy. A nation is competitive if it can succeed in free and fair world markets, while at the same time raise its people's standard of living. In other words, the standard of living has to be earned and no-one can bestow it upon us as a national or human right! In the future there will have to be more collaboration between industry, academics and Government. Surprisingly, this struggle has been going on for the last 30 years.

We all know that on paper, the multi-fibre arrangement is reputedly an extensive and successful regulation of textile and apparel imports. I recently had a grand-stand seat at our own negotiations along this line in the USA. This is the sort of arrangement that is going to be applicable to most other industries in the future as well. In other words, efforts to expand international markets will have to be towards finding a solution to manage international trade and ease out the disruptive influence this trade sometimes has on some markets.

While in Washington recently (as an advisor at our negotiations, I read a most appropriate book by Prof Lodge. Professor George Lodge's new book on "International Competitiveness" actually spells this out and says that the solution to the textile problem of the future is managed trade. He is a very liberal thinker and what he calls managed trades, others call competitive trade and what John Jay 200 years ago called "prudent trade". It is this International element that will be crucial to the whole textile industry in the coming years. It will be imperative that export performances will have to be built up and maintained between the various nations of the world, and that long run and are communicating more than ever before. This is the first prerequisite for good co-ordinated planning and it is essential if unnecessary counter-productive and ruinous competition is to be avoided in the future. Every effort is now being made at top levels to arrive at workable arrangements such as MFA serving the best interests of all those in the business. This I am sure, will be the pattern of the future. I have said this before and I do not mind repeating it: "We need not fear the future of the industry because we are a wealth producing industry creating high added values, as opposed to the services of wealth disposing industries such as mining, etc. Our industry caters to a basic and enduring need everywhere. It affords opportunities for artists, artisans, engineers and chemists, accountants and physicists, experts in marketing, financing and in many other fields. Above all, it demands inspiration and enterprise from its leaders."

Looking around at some of the very young people in the industry today, and knowing some of the youngsters who are being trained at our Technikon colleges, I am quite confident that these very same leaders of our industry in the future will find the means and the ways of how to plan and co-ordinate the industry on an international level. It was wonderful to see, at Monday evening's convocation ceremony, a completely new generation of younger S.A. technicians already honoured for their contribution to the S.A. textile scene.

Allow me to finish my brief talk to you this afternoon by quoting from a new book by Craig Hickman and M. da Silva called "Creating Excellence".

In the preface they write and I quote: "If we had to choose one essential characteristic of what we call the new age, that characteristic would be change. Until fairly recently executives operated with the assumption that they enjoyed limitless resources and plenty of time to build profitable enterprises, but today financial resources, new technology and accelerating change are placing unprecedented pressure on every organisation. Only those who learn to anticipate and even invent the future will profit from rather than be surprised by change" and, I also love the passage written by George Santayana: "We must welcome the future, remembering that soon it will be the past, and we must respect the past, remembering that it was once all that was humanly possible".

Thank you, Ladies and Gentlemen.

INSTITUTE NEWS

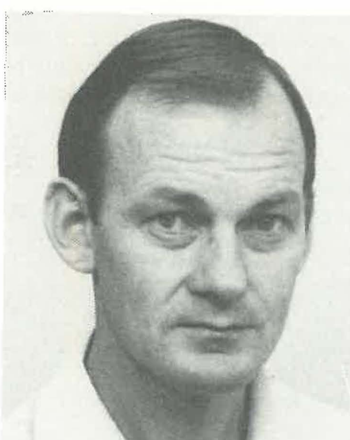
Chief Director on Overseas Visits

Dr D W F Turpie, Director of SAWTRI, attended the 55th International Wool Textile Organisation Conference in Oostende, Belgium, in June and presented two papers entitled: 1) "Rapid estimation of fibre length distribution in wool staples by means of information provided by the SAWTRI Length Strength Tester". 2) The correlations between different measures of weak places in worsted yarns and weaving performance". He followed this up with a visit to Istanbul, Turkey, where he attended the 13th Conference of the International Mohair Association to present a paper entitled: "The quantitative estimation of mohair in mohair/wool blends".

Working Groups meet at SAWTRI

The fifth annual meeting of Working Groups representing the South African Wool and Mohair Processors' Association, The South African Worsted Manufacturers' Trade Association (SAWMTA), The South African Cotton Textile Manufacturers' Association (SACTMA) and the National Federation Knitters' Trade Association (NFKTA) took place at the Institute during August to discuss proposals for the 1987/88 Research Programme to be followed at SAWTRI. In addition to these, a newly formed Working Group, representing the National Clothing Federation of South Africa (NCFSA), met for the first time on the 20th August with 16 delegates in attendance.

SAWTRI Staff Members Receive Awards at the Fifth S.A. Convocation of the Textile Institute



Mr S Smuts

The Fifth Convocation of the S.A. Section of the Textile Institute was held during the late afternoon on the opening day of the Symposium on "New Technologies for Textiles". This impressive ceremony is held every second year for awards of the Textile Institute to be made in respect of South African resident members who are unable to attend the Convocation held in Manchester, England. The President of the Textile Institute, Mr R W Goodall, presided over the Convocation and conferred 14 awards, two of which were received by two SAWTRI staff members.

Mr Stephen Smuts, Head of the Department of Textile Physics, received the Fellowship of the Textile Institute (FTI). Mr Smuts, who has been with SAWTRI since 1964, was awarded an M.Sc. degree in Textile Technology by the University of Port Elizabeth in 1973 and has to date some 70 technical publications to his credit as author or co-author, most of which are in the field of fibre and fabric testing.

Mr Alan Gilbert Brydon, textile technologist in the Woollen Processing Department, was presented with his Licentiateship of the Textile Institute (LTI). Mr Brydon, who joined SAWTRI in January 1983, has a number of publications to his credit as author or co-author, most of which are in the field of woollen spun wrap yarns.

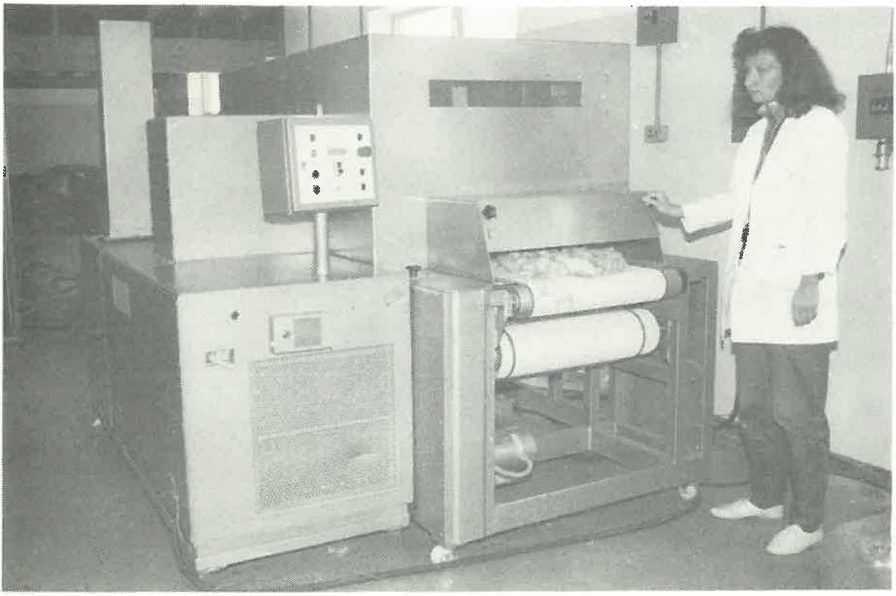
Mr A G Brydon

Radiofrequency Drying Machine Installed at SAWTRI

A Radiofrequency Drying Machine manufactured by FASTRAN Engineering, Scotland, was recently installed at SAWTRI. The machine with an 8 kW generator and operating at a frequency of 27,12 MHz, has a drying capacity of approximately 60 kg/hr fibre. It is mainly used for drying loose stock or sliver. A novel feature of the machine is that it incorporates an air circulation system, i.e. the hot air which is produced by the generator is utilised by circulating it through the fibres which are dried in the RF field. This results in a substantial saving in energy compared to normal RF drying techniques (which are already energy efficient compared with conventional drying techniques). In this particular dryer the temperature of the fibre during drying never exceeds $\pm$ 40 — 50°C thus avoiding overdrying and damage to the fibres.

Visitors to SAWTRI

During the period July — September, the following visitors paid visits to the Institute to discuss matters of mutual interest with certain members of SAWTRI staff: Mr K S Ski, IWS Director for Western Europe; Prof and Mrs J S Parker, Texas Tech. University, USA; Mr P Ingham, IWS, UK; Mr E White, Spinlab, USA; Mr G Leveroni and Mr G Ottini, Italy; Mr R Fürter, Zellweger, Switzerland; Prof H-H Wang, Feng Chia University, Taiwan, and Dr and Mrs J G Garbers, Human Sciences Research Council, RSA. During September three large groups of visitors were taken on conducted tours through some of the processing departments at the Institute, namely a group of wool farmers from the Cathcart district, some 40 students from the Grootfontein Agricultural College and a contingent of final year sheep and wool science students from the University of Stellenbosch.



SAWTRI'S new RF drying machine.

Mr N J Vogt explaining some aspects of dyeing to a number of sheep and wool science students from the University of Stellenbosch.

Dr J G Garbers, President of the HSRC (right) and Mrs Garbers in discussion with Dr D W F Turpie and Mr N J Vogt during their recent visit to SAWTRI.

Staff News

Mr K Bowker has been appointed as a Senior Technician from the 1st September in the Cotton Processing Department. His knowledge and experience gained over several years in various positions in the textile industry will certainly be of value to this department.

SAWTRI PUBLICATIONS

Since the previous edition of the Bulletin, the following papers were published by SAWTRI:

Technical Reports

No. 588 Bird, S.L., A Comparison of Cotton and Polyester/Cotton Sheeting Fabric during Laundering and Laboratory Abrasion and Pill Tests. (September 1986).

Papers by SAWTRI Authors Appearing in Other Journals

Galuszynski, S., Effect of Fabric Structure on Fabric Resistance to Needle Piercing. *Textile Research Journal,* **56**(5), 339 (1986).

Galuszynski, S., Some Aspects of the Mechanism of Seam Slippage in Woven Fabrics. *J. Text. Inst.* **76**(6), 425 (1985).

Galuszynski, S., Objective Measurement of Seam Pucker. *Proceedings: Symposium on New Technologies for Textiles,* Port Elizabeth, 100 (July 1986).

Hunter, L. and Sanderson, K.W., Short Fibre Content: Measurement and Effect on Cotton Processing and Yarn Properties. *Proceedings: Symposium on New Technologies for Textiles,* Port Elizabeth, 385 (July 1986).

Maasdorp, A.P.B. and Van Rensburg, N.J.J., New Instrumental Methods for Analysis in Textile Chemistry. *Proceedings: Symposium on New Technologies for Textiles,* Port Elizabeth, 758 (July 1986).

Robinson, G.A., Hunter, L. and Gee, E., Yarn Properties of Importance to Weaving and Knitting. *Proceedings: Symposium on New Technologies for Textiles,* Port Elizabeth, 657 (July 1986).

Turpie, D.W.F., Recent Developments in Machines and Instruments at SAWTRI. *Proceedings: Symposium on New Technologies for Textiles,* Port Elizabeth, 443 (July 1986).

Van der Merwe, J.P., From Fibre to Wrapped Yarn in a Single Operation on a Woollen Card. *Proceedings: Symposium on New Technologies for Textiles,* Port Elizabeth, 640 (July 1986).

Van Rensburg, N.J.J., Barkhuysen, F.A. and Maasdorp, A.P.B., Recent Developments in Lustre Measurements and Radiofrequency Bleaching and Dyeing. *Proceedings: Symposium on New Technologies for Textiles,* Port Elizabeth, 739 (July 1986).

Sanderson, K.W. and Hunter, L., Die Zusammenhänge zwischen verschiedenen Kurzfasermessungen, der Verspinnbarkeit und den Garneigenschaften. *Melliand Textilberichte,* **67**, 463 (1986).

CONTINUOUS DYEING USING RADIO FREQUENCY ENERGY

PART VII : SIMULTANEOUS DYEING AND FLUORO-CARBON SOIL-RESIST TREATMENT OF SYNTHETIC FIBRES

by

F A BARKHUYSEN, G GRIMMER and N J J VAN RENSBURG*

ABSTRACT

The simultaneous dyeing and soil-resist treatment of acrylic, nylon and polyester carpet fibres with fluorocarbon compounds in an RF dyeing machine was investigated. All the dyeings were level and fibres treated in this manner had acceptable soil resistance, this property generally being fast towards washing and shampooing. The presence of fluorocarbon compounds in the dye liquors had no detrimental effect on the wash-, rubbing- and lightfastness of the dyed fibres.

INTRODUCTION

The manufacture of carpets is a fairly specialised field and in addition, carpets have to meet a number of specialised requirements, for example, soil resistance. Various methods can be used to produce soil resistant carpets such as by the application of appropriate chemicals or the use of "soil-hiding" or soil resistant fibres.

The most important group of agents used for imparting soil resistance to textile floor coverings are the fluorochemical compounds[1] such as the fluorocarbons[2,3]. One of the most commonly used methods for the soil-resist treatment of carpets is by spraying the fluorocarbon agent onto the carpet before it enters the dryer in the dyehouse or prior to it entering the carpet backing unit. Upon drying, the soil-resist agent is fixed to the fibres[4].

Studies carried out at SAWTRI showed that acrylic, nylon and polyester carpet fibres could be successfully dyed using radio frequency (RF) energy[5]. The question then arose whether these fibres could be simultaneously dyed and soil-resist treated by means of RF energy. This would not only simplify the processing of the fibres but could also lead to some savings in energy and labour. A study was therefore carried out to established whether various synthetic fibres could be simultaneously dyed and soil-resist treated using a

*Romatex Mills

fluorocarbon compound in an RF dyeing machine and whether the fastness of the soil-resist agent to washing and shampooing as well as its effect on the fastness properties of the dyed substrate, were satisfactory.

EXPERIMENTAL

Material

Nylon tops (ICI Type 322 P and Du Pont Type 813A), Vonnel acrylic tow (Type V17) and polyester tops (Trevira Type 810 and 823) were used in this study. For purposes of comparison, Du Pont Nylon Type 391A, which contained a fluorocarbon soil-resist agent (applied by means of a lick-roller immediately after extrusion), was also included. This particular type of nylon was RF dyed only, i.e. no additional fluorocarbon was applied.

Chemicals

Commercial grade dyes, chemicals and auxiliaries were used. Two cationic fluorocarbon soil-resist agents namely ®FC393 "Scotchgard" Brand Carpet Protector (3M) and ®Statexan SF (Bayer) were used.

Simultaneous RF dyeing and soil-resist treatment

(a) Machine

The simultaneous dyeing and soil-resist treatment of the tow or tops was carried out on a pilot scale Fastran Continuous Top Dyeing machine described previously[6]. The anode current was set at 400 mA to produce a temperature of 115°C in the reaction tube.

(b) Treatment liquors

The treatment liquors were applied to the fibres by means of a pad application. The dwell time of the fibres in the tube was approximately 35 minutes.

After treatment, the fibres were rinsed in water at 50°C followed by a dry-heat treatment in an oven for 5 min at 110°C, as recommended by the manufacturers of fluorocarbon compounds.

(i) Acrylic tow was padded to a 70% wet pick-up with dye solution containing:-

0,045% ®Astrazon Golden Yellow GLE (200%)
0,014% ®Astrazon Red GTLN (200%)
0,009% ®Astrazon Blue F2RL (200%)
4 g/ℓ ®Irgapadol PAC (accelerator)
x g/ℓ ®Lameprint 651 (thickener)
0,5 to 0,75 g/ℓ Tartaric Acid
x g/ℓ Fluorocarbon (®Scotchgard FC 393 or ®Statexan SF)

(ii) The nylon tops were padded to a 70% wet pick-up with a dye solution containing:-

0,6% ®Lanacron Yellow SR
0,1% ®Lanacron Red SG
0,12% ®Lanacron Navy Blue SG 150%
x g/ℓ ®Lameprint 651
0,5 to 0,75 g/ℓ Tartaric Acid
x g/ℓ Fluorocarbon (®Scotchgard FC 393 or ®Statexan SF)

(iii) The polyester tops (®Trevira type 810 and type 823), were padded to wet pick-ups of 60% and 100% respectively, with dye solution containing:-

0,25% ®Samaron Yellow Brown R5 LS
0,05% ®Samaron Red 2 BSL
0,03% ®Samaron Blue GSL
x g/ℓ ®Lameprint 651
0,5 to 0,75% Tartaric Acid
x g/ℓ Fluorocarbon (®Scotchgard FC 393 or ®Statexan SF)

(c) Tests

The resistance of the fibres to soiling was determined by means of an Allied Chemicals ®Anso IV Surface Energy Test Kit using an oil based fluid (Test fluid I) and a 30% isopropanol/70% water based fluid (Test fluid II). According to the manufacturers, both test fluids determine soil resistance while Test fluid II also detects residual detergent, wetting agent, gums, etc. on the fibre. The presence of these agents will therefore influence the sensitivity of the fluid II test. Test fluid I demonstrates "good" soil resistance, while Test fluid II demonstrates "adequate" soil resistance. A drop of the test fluid was gently placed on the surface of the fibres from a height of less than 0,3 cm (⅛"). The beading of the liquid after 30 seconds was taken as a measure of the soil resistance of the fibres. A bead which sparkled indicated no wetting (i.e. adequate or good soil resistance depending on the test fluid), whereas a dark bead, or no bead indicated wetting (i.e. poor soil resistance).

The colourfastness and the resistance of the fluorocarbon treatment to washing were determined by means of the ISO 2 washfastness test, while the colourfastness to shampooing was determined according to the BS 1006 : 1978 method. The effect of shampooing on the soil resistance of the fibres was also determined. The dry and wet rubbing fastness of the samples were determined on an AATCC Crockmeter according to standard procedures. The lightfastness of the fibres was determined according to SABS method 405.

RESULTS AND DISCUSSION

An inspection of the dyed and soil-resist treated fibres revealed that level dyeings were obtained on all fibres and no differences could be detected between the dyeings performed in the absence or presence of the fluorocarbon compounds. In other words the soil-resist agents did not adversely affect the dyeing behaviour of the fibres. Table 1 shows that excellent wash, rubbing and lightfastness ratings were obtained in all cases. Clearly the presence of the fluorocarbon soil-resist agents applied in the dye liquor did not affect the fastness ratings of the dyed fibres.

The effect of different fluorocarbon compounds on the soil resistance of the fibres is shown in Table 2. Furthermore, the effect of repeated washing is also shown. It is clear that fluorocarbon soil-resist agents could be successfully applied to acrylic, nylon and polyester fibres in a one-step dyeing and soil-resist finishing treatment in an RF dyeing machine. Whereas the fibres which had been dyed only (i.e. no fluorocarbon compound added to the dye liquor), failed the soiling tests, all the fibres which had been dyed in the presence of fluorocarbon passed the tests, irrespective of fibre type or type and concentration of fluorocarbon.

Table 2 also shows that the fibres retained their soil resistance even after 5 washing cycles (with the exception of one specific fluorocarbon which failed the Test fluid II test in the case of the acrylic fibres). It is also interesting to note that the soil resistance of the nylon fibres (types 322P and 813A), which were simultaneously dyed and treated with fluorocarbon in the RF machine, were similar to those of the nylon (type 391A) which was supplied by the fibre manufacturers as a soil-resist fibre.

Finally, the effect of shampooing on the fastness to washing and soil resistance of the fibres was determined. Table 3 shows that shampooing had no effect on the washfastness of the different fibres. Furthermore, shampooing had no effect on the soil resistance of the fibres as determined by the Test fluid I test. On the other hand, some of the fibres (®Vonnel V17 treated with both fluorocarbons and ®Trevira 823 treated with ®Statexan SF) failed the Test fluid II test. It is possible, however, that these fibres absorbed the surfactant solution (dodecyl sodium sulphate and monoisopropanolamide) used in the shampooing test thereby negating the effect of the soil-resist agents.

SUMMARY AND CONCLUSION

Some trials were carried out to establish the feasibility of applying fluorocarbon soil-resist agents to various synthetic fibres (acrylic, nylon and polyester) during a simultaneous dyeing and soil-resist treatment in an RF Dyeing machine.

Two different fluorocarbon compounds were evaluated. It was found that the soil-resist agents had no effect on the dyeing behaviour of the fibres and level dyeings were obtained in all cases. Furthermore, the fluorocarbons had no effect on the wash, rubbing and lightfastness of the dyed fibres. All the treated fibres showed good soil resistance. In most cases the soil-resist agents

TABLE 1

SOME FASTNESS RATINGS OF SIMULTANEOUSLY DYED AND SOIL-RESIST TREATED FIBRES

FIBRE	FLUOROCARBON	ISO 2 WASHFASTNESS TEST							RUBBING FASTNESS		LIGHT-FAST-NESS
		EFFECT ON SHADE	STAINING								
			Cellulose Acetate	Cotton	Nylon 6.6	Polyester	Acrylic	Wool	Dry	Wet	
Vonnel V17	—	5	5	5	5	5	5	5	5	5	7
Vonnel V17	40 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	5	4-5	7
Vonnel V17	80 g/ℓ Statexan SF	5	5	5	5	5	5	5	5	5	7
Nylon 322 P	—	5	5	5	5	5	5	5	5	4-5	7
Nylon 322 P	20 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	5	4-5	7
Nylon 813 A	20 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	5	5	7
Nylon 813 A	60 g/ℓ Statexan SF	5	5	5	5	5	5	5	5	5	7
Nylon 391A*	—	5	5	5	5	5	5	5	5	5	7
Trevira 810	—	5	5	5	5	5	5	5	5	4-5	7
Trevira 810	40 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	5	5	7
Trevira 810	60 g/ℓ Statexan SF	5	5	5	5	5	5	5	5	5	7
Trevira 823	—	5	5	5	5	5	5	5	5	5	7
Trevira 823	40 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	4-5	5	7
Trevira 823	80 g/ℓ Statexan SF	5	5	5	5	5	5	5	5	4-5	7

*Soil-resist fibre supplied by manufacturer.

TABLE 2

SOIL RESISTANCE OF DIFFERENT FIBRES TREATED WITH FLUOROCARBON AND DYE

FIBRE	TREATMENT LIQUOR			SOIL-RESIST RATING							
	VISCOSITY	pH	FLUOROCARBON	TEST FLUID I				TEST FLUID II			
				ISO2 WASH TEST				ISO2 WASH TEST			
				0	1x	2x	5x	0	1x	2x	5x
Vonnel V17	110	4,0	—	F	—	—	—	F	—	—	—
Vonnel V17	120	3,4	40 g/ℓ Scotchgard FC 393	P	P	P	P	P	P	P	P
Vonnel V17	200	4,1	80 g/ℓ Statexan SF	P	P	P	P	P	F	—	—
Nylon 322P	90	4,5	—	F	—	—	—	F	—	—	—
Nylon 322P	120	3,4	20 g/ℓ Scotchgard FC 393	P	P	F	—	P	P	P	P
Nylon 813A	120	3,4	20 g/ℓ Scotchgard FC 393	P	P	P	P	P	P	P	P
Nylon 813A	215	4,7	60 g/ℓ Statexan SF	P	P	P	P	P	P	P	P
Nylon 391A*	200	4,5	—	P	P	P	P	P	P	P	P
Trevira 810	200	4,7	—	F	—	—	—	F	—	—	—
Trevira 810	120	3,4	40 g/ℓ Scotchgard FC 393	P	P	P	P	P	P	P	P
Trevira 810	210	4,6	60 g/ℓ Statexan SF	P	P	P	F	P	P	P	P
Trevira 823	200	4,7	—	F	—	—	—	F	—	—	—
Trevira 823	120	3,4	40 g/ℓ Scotchgard FC 393	P	P	P	P	P	P	P	P
Trevira 823	210	4,6	80 g/ℓ Statexan SF	P	P	P	P	P	P	P	P

F = Fail; P = Pass
*Soil-resist fibre supplied by manufacturer

TABLE 3

EFFECT OF SHAMPOOING ON THE WASHFASTNESS AND SOIL RESISTANCE OF FLUOROCARBON TREATED FIBRES

FIBRE	FLUOROCARBON	ISO 2 WASHFASTNESS							SOIL RESISTANCE	
		EFFECT	STAINING						TEST FLUID	
		ON SHADE	Cellulose Acetate	Cotton	Nylon 6.6	Polyester	Acrylic	Wool	I	II
Vonnel V17	—	5	5	5	5	5	5	5	F	F
Vonnel V17	40 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	P	F
Vonnel V17	80 g/ℓ Statexan SF	5	5	5	5	5	5	5	P	F
Nylon 322 P	—	5	5	5	5	5	5	5	F	F
Nylon 322 P	20 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	P	P
Nylon 813 A	20 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	P	P
Nylon 813 A	60 g/ℓ Statexan SF	5	5	5	5	5	5	5	P	P
Nylon 391A*	—	5	5	5	5	5	5	5	P	P
Trevira 810	—	5	5	5	5	5	5	5	F	F
Trevira 810	40 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	P	P
Trevira 810	60 g/ℓ Statexan SF	5	5	5	5	5	5	5	P	P
Trevira 823	—	5	5	5	5	5	5	5	F	F
Trevira 823	40 g/ℓ Scotchgard FC 393	5	5	5	5	5	5	5	P	P
Trevira 823	80 g/ℓ Statexan SF	5	5	5	5	5	5	5	P	F

P = Pass; F = Fail

*Soil-resist fibre supplied by manufacturer were fast to repeated washing, with the exception of one specific compound on the acrylic fibres. Shampooing had no effect on the colourfastness of the treated fibres. The soil-resist agents were fast to shampooing as determined by one specific soiling test, but in the case of the isopropanol/water based test, both soil-resist agents on the acrylic fibres and one product on one specific polyester type, failed the test. This may have been due to the fact that residual surfactant which remained on the fibres after the shampooing treatment, affected the soil resistance test.

A comparison between the fibres which were dyed and soil-resist treated in the RF dyeing machine, and those fibres which were supplied by the fibre manufacturers as soil resistant, generally showed no difference in soil resistance or dyeing behaviour.

It is concluded that the application of soil-resist agents to fibres used for carpets can be carried out simultaneously with dyeing during an RF dyeing process.

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USE OF PROPRIETARY NAMES

The fact that products with proprietary names have been used in this report does not imply that SAWTRI recommends them and that there are no substitutes which may be of equal or better value.

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A NOTE ON THE EFFECT OF SINGLES AND PLYING TWIST ON THE TENSILE PROPERTIES OF THREE-PLY WOOL WORSTED YARNS

by

H. J. VAN AARDT and L. HUNTER

ABSTRACT

The influence of singles and plying twist on the tensile properties of three-ply wool yarns has been investigated. Levels and combinations of singles and three-ply twist to give optimum tensile properties have been arrived at. A means of predicting the resultant linear density from the single yarn linear density and plying twist have been derived.

INTRODUCTION

Although three-ply yarns are not commonly used, they do find applications in certain specialised fields and SAWTRI was approached by a South African spinning mill for information on the effects of singles and plying twist levels on three-ply yarn properties. Because of a lack of published information in this field, it was decided to carry out an investigation on the effect of singles and plying twist on the yarn properties for conventional three-ply yarns with particular reference to yarn tensile properties.

EXPERIMENTAL

Wool with a mean fibre length of 57,3 mm (CV = 54,3%) and mean fibre diameter of 20,9 μm was used. Singles yarns (23 tex nominal) were spun on a ring spinning frame at four different levels of twist, namely: 420, 520, 625 and 730 turns per metre (Table 1). Three ends of singles yarns of a specific twist

TABLE 1

PROPERTIES OF SINGLES YARNS (23 tex)

Nominal Twist (turns/m)	Linear Density (tex)	Tenacity	Extension (cN/tex)	Irregularity (%)	Thin Places (per 1 000m)	Thick Places (per 1 000m)	Neps (per 1 000m)	Hairiness (Hairs/m)
420	22,5	5,6	6,6	18,1	217	71	21	25
520	22,1	6,1	9,6	18,0	213	64	17	22
625	21,8	6,3	13,6	18,3	241	81	21	23
730	21,7	6,4	13,6	18,5	270	89	23	26

TABLE 2

STRUCTURAL DETAILS AND TENSILE PROPERTIES OF THREE-PLY YARNS

Nominal	Linear Density (tex)	Tenacity (cN/tex)	Extension (%)	Nominal	Linear Density (tex)	Tenacity (cN/tex)	Extension (%)
R69 tex S225/3Z420	66,2	7,4	14,9	R69 tex S700/3Z520	72,6	9,3	37,7
S275/3Z420	66,5	7,8	20,6	S200/3Z625	65,5	7,5	13,9
S320/3Z420	66,6	8,1	22,2	S340/3Z625	66,7	8,5	27,3
S370/3Z420	66,9	8,6	27,8	S410/3Z625	66,1	8,9	29,7
S420/3Z420	67,8	8,7	30,3	S485/3Z625	67,6	9,0	31,4
S520/3Z420	68,8	9,0	31,7	S555/3Z625	70,4	9,0	33,7
S600/3Z420	69,9	9,1	33,9	S625/3Z625	69,0	9,3	35,9
S700/3Z420	71,4	8,8	36,0	S700/3Z625	69,3	9,0	35,9
S200/3Z520	67,8	7,5	13,0	S200/3Z730	65,4	7,7	14,2
S280/3Z520	67,4	8,1	20,9	S300/3Z730	67,2	8,3	21,9
S340/3Z520	68,6	8,4	24,7	S410/3Z730	68,1	8,9	31,6
S400/3Z520	69,1	8,8	29,7	S480/3Z730	68,4	9,1	33,9
S460/3Z520	70,0	9,1	31,9	S570/3Z730	68,8	9,1	35,3
S520/3Z520	70,1	9,3	34,8	S650/3Z730	70,0	9,0	37,3
S600/3Z520	71,6	9,2	34,8	S730/3Z730	72,0	8,8	38,9

were plied to form three-ply yarns using plying twists varying from 200 through to 730 turns per metre. In all, 30 three-ply yarns were produced (Table 2). The singles yarns were twisted in the Z direction and the plying was done in the S direction.

RESULTS AND DISCUSSION

From Table 2 it can be seen that the tenacity of the three-ply yarns of constant singles twist increased with increasing plying twist until it reached a maximum after which it decreased with further increase in plying twist. This is similar to the results obtained by Dakin[1] for three-ply cotton yarns. At a constant plying twist, tenacity increased with increasing singles twist. These trends are illustrated in Fig. 1.

A multiple regression analysis was carried out with tenacity as the dependent variable, and singles twist (X_1) and plying twist (X_2) as the independent variables and the following best fit regression equation was obtained:

$$\text{Tenacity} = 8{,}21 \times 10^{-3}X_1 + 1{,}54 \times 10^{-2}X_2 - 5 \times 10^{-6}X_1^2 - 3 \times 10^{-6}X_1X_2 - 1{,}2 \times 10^{-5}X_2^2 + 2{,}4 \qquad (1)$$

Multiple correlation coefficient (r) = 0,99.

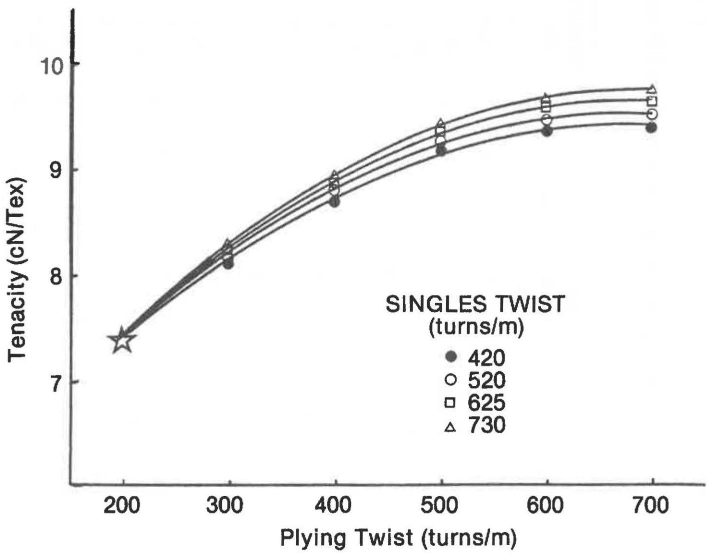

Fig. 1: Regression curves relating the effects of Singles and Plying Twist on Yarn Tenacity.

By differentiating equation (1) with respect to X_2 (plying twist) it is possible to obtain the relationship between plying twist and singles twist which will produce yarns with a maximum tenacity (equation (2)).

Plying twist = $-0{,}13$ (singles twist) + 640 .... (2)

The above equation is shown in Fig. 2. From this figure it is apparent that increasing singles twist requires a decrease in plying twist to produce a yarn with maximum tenacity.

A multiple regression analysis was carried out with tenacity as the dependent variable and singles twist factor (X_1) and plying twist factor (X_2) as the independent variables, and the following best fit equation was obtained:

$$\text{Tenacity} = 0{,}17\,X_1 + 0{,}18\,X_2 - 2{,}43 \times 10^{-3}\,X_1^2 - 8{,}42 \times 10^{-4}\,X_1X_2 - 1{,}60 \times 10^{-3}\,X_2^2 + 2{,}5 \quad (3)$$

$$r = 0{,}99$$

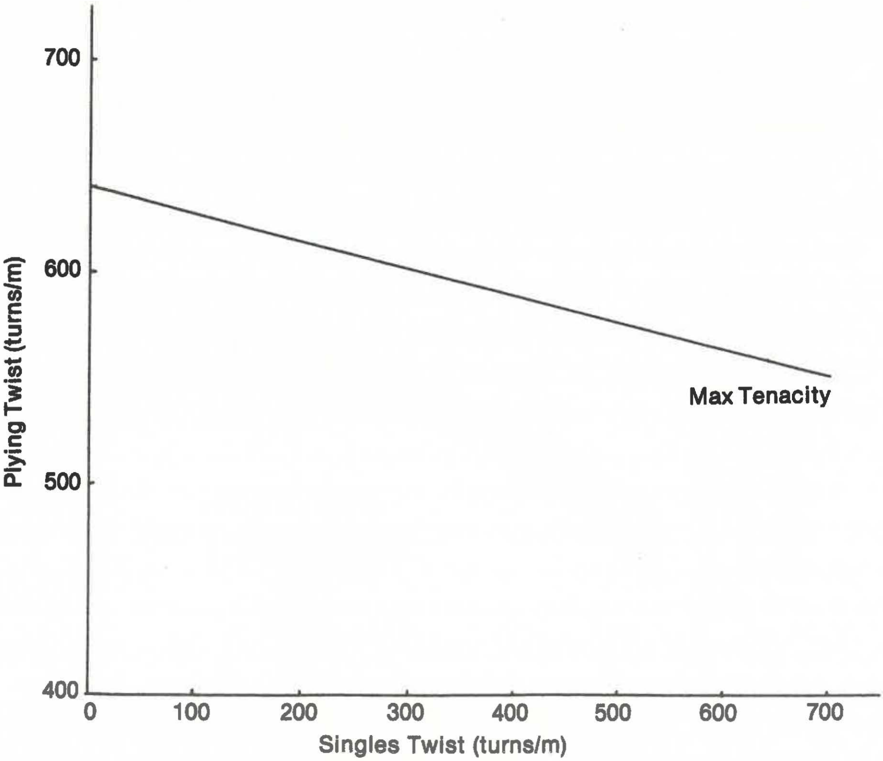

Fig. 2: The Relationship between Singles and Plying Twist required to produce a Three-Ply Yarn with maximum tenacity.

The extension values (Table 2) showed a similar trend to the tenacity values, extension increasing with increasing plying twist at a constant singles twist. At a constant plying twist extension increased very slightly with increasing singles twist. These trends are illustrated in Fig. 3.

A multiple regression analysis, carried out with extension as the dependent variable and singles twist (X_1) and plying twist (X_2) as the independent variable yielded the following best fit equation:

$$\text{Extension} = 0{,}13\,X_2 + 1 \times 10^{-5} X_1X_2 - 1 \times 10^{-4} X_2^2 - 9{,}1 \quad \ldots\ldots\ldots (4)$$
$$r = 0{,}99$$

By solving equations (1) and (4) the expected tenacity and extension values can be calculated for various combinations of singles and plying twist (Table 3). The values in Table 3 can be used as a guide to choose levels of singles twist and plying twist to give a three-ply yarn with a certain tenacity and extension. For example, to spin a three-ply yarn with a tenacity of 8 cN/tex and extension of 25%, a singles twist of 200 turns/m and plying twist of 400 turns/m should be used.

A multiple regression analysis, carried out with extension as the dependent variable and singles twist factor (X_1) and plying twist factor (X_2) as the independent variables, yielded the following best fit equation:

$$\text{Extension} = 1{,}50\,X_2 + 2{,}8 \times 10^{-3} X_1X_2 - 1{,}4 \times 10^{-2} X_2^2 - 7{,}9 \quad \ldots\ldots (5)$$
$$r = 0{,}99$$

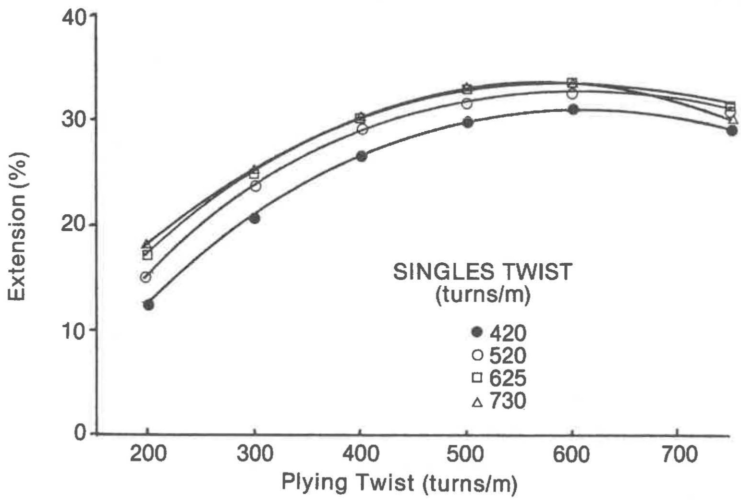

Fig. 3: Regression Curves illustrating the Effects of Singles and Plying Twist on Yarn Extension.

TABLE 3

PREDICTED TENACITY (cN/tex) AND EXTENSION (%) VALUES WHEN USING THE FOLLOWING SINGLES AND PLYING TWISTS (turns/m)

Singles Twist →	200		300		400		500		600		700	
Plying Twist	**Ten.**	**Ext.**	**Ten.**	**Ext.**	**Ten.**	**Ext.**	**Ten.**	**Ext.**	**Ten.**	**Ext.**	**Ten.**	**Ext.**
200	6,3	13,1	6,8	13,3	7,2	13,5	7,5	13,7	7,7	13,9	7,8	14,1
300	7,2	21,1	7,6	21,4	8,0	21,7	8,3	22,0	8,5	22,3	8,6	22,6
400	7,8	27,2	8,2	27,6	8,6	28,0	8,9	28,4	9,0	28,8	9,1	29,2
500	8,2	31,3	8,6	31,8	8,9	32,3	9,2	32,8	9,3	33,3	9,3	33,8
600	8,3	33,4	8,7	34,0	9,0	34,6	9,2	35,2	9,3	35,8	9,3	36,4
700	8,3	33,4	8,6	34,1	8,9	34,8	9,0	35,5	9,1	36,2	9,1	36,9

Yarn irregularity was fairly constant varying between 10,4 CV% and 11,9 CV% and was not affected by either singles twist or plying twist.

Hairiness tended to decrease slightly with an increase in singles twist (16 to 25 hairs/m with a singles twist of 420 and 9 to 15 hairs/m with a singles twist of 730 turns/m).

The number of imperfections varied between 0 and 7 per 1 000 m but no trend with twist was observed.

Effect of Twist on Resultant Linear Density

From Table 2 it can be seen that, as expected, increasing plying twist increased yarn linear density when singles twist was constant.

A multiple regression analysis was carried out on the nominal plying twist values and actual yarn linear density values. Singles twist showed no contribution and does not affect the resultant yarn linear density. Resultant yarn tex, Y, was the dependent variable with plying twist (X_1), and singles linear density (X_2), as the independent variables.

$$Y = 4,6 \times 10^{-4} X_1X_2 + 63,9 \qquad (6)$$

$$r = 0,86$$

Equation (6) can indicate to a spinner wishing to produce a three-ply yarn, the expected amount of take-up due to twist.

SUMMARY AND CONCLUSION

The effect of singles twist and plying twist on the tensile properties of three-ply wool worsted yarns was investigated. Singles yarns (23 tex) were spun at four different twist levels (Z-direction), namely 420, 520, 625, 730 turns/m . Three-ply yarns were produced from each of these singles yarns, at plying twists ranging from 200 to 730 turns/m (S-direction).

The tenacity of the three-ply yarns varied between 7,4 cN/tex and 9,3 cN/tex, and the extension varied between 14,2% and 38,9% depending on the combination of singles and plying twist used.

Yarn tenacity increased with increasing plying twist and increasing singles twist, until a maximum was reached after which it decreased with further increase in twist. Yarn extension increased with increasing plying twist and was only slightly influenced by singles twist. Yarn irregularity and yarn imperfections were not influenced by either plying twist of singles twist. Hairiness tended to decrease slightly with increasing singles twist. Plying twist, within the ranges studied, generally had a far more important effect on the yarn tensile properties than singles twist, it being preferable to use a relatively low singles twist together with a relatively high plying twist. This could, however, lead to problems with twist liveliness.

Equations have been derived which enable yarn tenacity and extension to be predicted from the singles and plying twist and twist factors. Similar trends should apply to other yarn linear densities although it would be necessary to adjust absolute twist levels so that the twist factors are similar to those used here.

ACKNOWLEDGEMENTS

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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.

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