SAWTRI BULLETIN

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

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Editor: P. de W. Olivier, B.Sc.

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PUBLICATIONS COMMITTEE

SEASON'S GREETINGS

As 1974 rapidly draws to a close, the Director and staff of the Institute wish to extend to our readers our very best wishes for the approaching Christmas season and the new year of 1975. We would also like to thank all those individuals and organisations who have contributed to the work of the Institute, financially, or otherwise, over the past year. We look forward to the same and extended cooperation in the new year.

SAWTRI has had a busy year. This is reflected by the record number of Technical Reports published, the diversity of which also reflects the Institute's ever widening field of textile research. It is our sincere wish that time, effort, and money spent on scientific research will find increased application in the entire industry. We, as a scientific research organisation are concerned with industry in general and textiles in particular and as such our efforts are directed at the well-being of all facets of the industry thus contributing to the wellbeing of the country as a whole. In spite of certain drawbacks we are nevertheless, optimistic about the future and we firmly believe that as far as the textile industry is concerned, the interaction between research and industry must eventually benefit all concerned. It is in this firm belief that we shall continue unabatedly to serve the textile industry at as many levels as possible and to the best of our ability and of what our financial resources will allow.

INSTITUTE NEWS

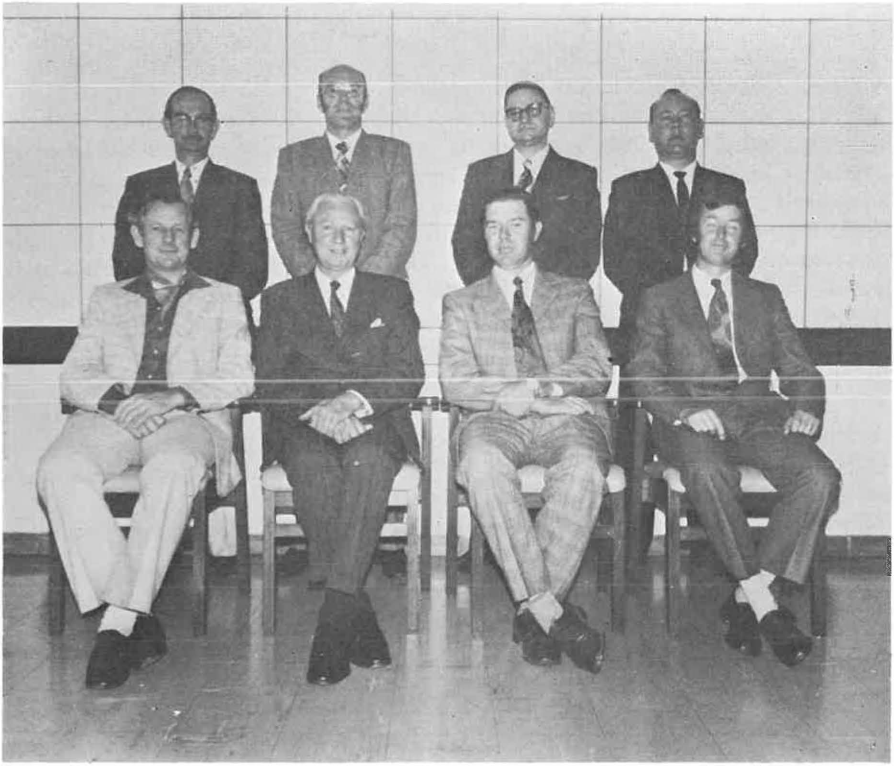
Research Advisory Committee

It is with regret that we have to take leave of Dr C. M. (Charles) van Wyk as a member of the R.A.C. Dr Van Wyk has been associated with SAWTRI since the Institute's inception having served on various committees and, since the CSIR's involvement with the Institute, the Research Advisory Committee for the best part of twenty years. During this time, Dr Van Wyk has endeared himself to all at the Institute. His valuable contribution to the Institute's research has not gone unnoticed and we wish to thank him for the work he has done. We extend to Dr Van Wyk our best wishes for a well earned and happy retirement.

Dr Van Wyk is to be succeeded by Dr J. H. Hofmeyr, Director of the Animal and Dairy Science Research Institute.

We take pleasure in announcing the appointment to the Research Advisory Committee of Dr J. R. McPhee, Director of Research and Development at the Technical Laboratories of the I.W.S. in Ilkley, Yorkshire. Dr McPhee succeeds Dr Gerald Laxer who has been appointed Managing Director Designate, of the International Wool Secretariat. We would like to take this opportunity to thank Dr Laxer for his valuable work on the Committee.

DR C. M. VAN WYK



COTTON RESEARCH STEERING COMMITTEE

Seated left to right: Mr P. Johnston, Product Development Executive, Cotton Promotion Council of Rhodesia; Mr N. J. Vogt, Regional Liaison Officer, CSIR (Secretary); Mr W. D. C. Reed, of the Rhodesian Cotton Research Advisory Committee (Chairman); Mr K. Sanderson of the Rhodesian Cotton Research Advisory Committee.
Standing in the usual order: Dr N. J. J. van Rensburg, Group Leader for Protein and Cotton Chemistry; Dr De V. Aldrich, Group Leader for Cotton Processing; Dr D. P. Veldsman, Director of SAWTRI and Dr E. C. Hanekom, Head of Cotton Chemistry.

Research Advisers

Mr E. R. Leeman, Assistant Director of the National Research Institute for Mechanical Engineering of the CSIR will assume duties as adviser on matters pertaining to engineering aspects of textiles on April 1st, 1975. In this capacity he succeeds Dr Kemp, Vice-President of the CSIR who served as adviser for the past two years. We welcome Mr Leeman and we look forward to his visits to SAWTRI. At the same time we wish to thank Dr Kemp for his most valuable advice and cooperation.

Professor W. J. McGill, who lectures in Polymer Science at the University of Port Elizabeth, has been appointed adviser in matters relating to textile chemistry and processing. Prof. McGill assumes duties in this capacity on April 1st, 1975. He succeeds Dr Sanderson of the University of Stellenbosch.

Transfer of Fibre Research Unit

The Fibre Research Unit, stationed at Durban will henceforth, from January 1st, 1975, operate on the SAWTRI campus. While in Durban, the unit devoted most of its efforts to developing a small decorticator based on the Elgin decorticator (see Technical Report No. 232). In this regard we have pleasure in announcing that Messrs Elgin Engineering in Jacobs, Natal have agreed in principle to manufacture this new decorticator developed by the Fibre Research Unit in preference to the one which the firm has been producing until now. Although the decorticator presently in use will be phased out of production, spare parts will still be available for a considerable time. The new machine is capable of delivering three quarters of a ton of fibre per eight hour shift and should firms, co-operatives, farmers or other interested parties wish to acquire such a machine, the manufacturing firm mentioned may be approached directly.

Future research on the decortication of *Phormium tenax* will to a very large extend depend on the clarification of a number of policy issues in view of Phormium production being considered as mainly one of the Bantu homelands industries.

The Cotton Scene

The Rhodesian Cotton Growers' Association and the Cotton Promotion Council of Rhodesia have joined forces in becoming guaranteed long term contributors to SAWTRI. A Steering Committee under the Chairmanship of Mr W. D. C. Reed of the Rhodesian Cotton Growers' Association and Mr Neville Vogt, Regional Liaison Officer of the CSIR at SAWTRI as Secretary has been set up to control research projects undertaken in terms of the agreement reached in this connection.

Senior Staff Activities

Dr D. W. F. Turpie, Group Leader for Scouring, Carding and Combing, Spinning and Workshop matters, attended a conference on "Treatment of Wool Scouring Effluent" organised by the CSIRO in Geelong, Australia on October 2nd and 3rd. Dr Turpie reported on SAWTRI's work in this field.

The Director, Dr D. P. Veldsman, attended the last meeting of the Research and Development Committee of the IWS for 1974 in Ryde, Sydney, Australia on November 6th and 7th. Henceforth, meetings will be held at Ilkley, U.K. once a year only.

On November 15th the Director presided over a meeting of interested parties to appoint an Action Committee for the next National Conference on Textile

Training to be held in June 1975, which is being organised jointly by the Textile Institute and the CSIR. During the afternoon the Director was in the Chair for the annual meeting and last for 1974 of the Advisory Committee of the Textile Institute in Pretoria. As membership of this Committee is rotational, Dr Veldsman, after the meeting, retired as member of the Committee for a minimum period of one year.

On October 25th the Director attended the annual meeting of the Advisory Committee to the National Chemical Research Laboratory of the CSIR in Pretoria.

The Director, who is a member of the Steering Committee for "Research into the Recycling of Water and the Recovery of Chemicals in the Textile Industry", attended a meeting of this Committee at the Department of Chemical Engineering of the University of Natal in Durban on October 28th.

Fibre Research Unit Leader to Retire

SAWTRI takes leave of Mr J. J. Gerritsen at the end of December when he retires after many years of service in the CSIR. Mr Gerritsen joined the CSIR in 1960 as a staff member of the National Mechanical Engineering Research Institute. Various assignments included control of the Mine Equipment Research Unit and conducting a design study of a proposed National Testing Station. Interspersed with this work were investigations into natural long fibres which eventually became his full time work leading to a transfer to SAWTRI. His technical knowledge and successful investigation into the processing of long fibres led to a

MR J. J. GERRITSEN

special assignment by the Department of Industries in connection with the processing of *Phormium tenax,* a task which he has pursued with dedication. His most recent achievement, the development of a small decorticator for *Phormium tenax* leaves is a fitting seal on his engineering research activities. Where Mr Gerritsen intends settling in the country of his wife's birth, the United Kingdom, we wish them every happiness and a restful retirement. Mr Gerritsen has hinted that he may continue, in his own time and at a pace fitting to a retired gentleman, with his investigations into natural vegetable fibres such as those with which he has lately been associated. We bid him "au revoir", and "thank you" for his services.

Staff Matters

A number of new appointments have been made at the Institute:

Mrs A. J. van Heerden has taken the place of Miss M. E. Pienaar as the Director's personal assistant. Miss Margaret Fouché takes the place of Miss M. Terblanche as Librarian. Mr R. A. Leigh has been appointed to the staff of Cotton Chemistry and is in charge of Cotton Finishing. Dr M. B. Roberts is the new Group Leader for Dyeing and Finishing. Dr A. P. N. Hayes becomes Head of Dyeing. Dr R. E. Horn has joined the staff of the Protein Chemistry Division, Mr G. Andrews that of Textile Physics and Mr J. N. Maskrey is SAWTRI's new electronics technician.

The Publications Division which had been functioning under the Group Leadership of the Director has been transferred to the General Administration Group under the leadership of the Secretary, Mr G. Fouché.

Mr Harold Silver, Head of Dyeing, left for Europe on October 1st, to receive training in the wool textile finishing field at the IWS Technical Centre in Ilkley, Yorkshire. Mr Silver will be away for some six months.

Dr I. Kelly of Textile Physics and Mr M. Cawood of Knitting, have been selected to attend the International Wool Conference in Aachen in 1975 as guests of the Conference. This is in terms of the "Younger Textile Scientists International Project" in order that their knowledge in their particular fields may be broadened. The two SAWTRI staff members are part of a group of some 30–35 young scientists from Germany and abroad. After the conference a number of textile research institutes and mills in Germany will be visited during a bus tour which will include centres such as Krefeld, Wuppertal, and Bremen.

New Subscribers

Messrs B. M. D. Knitting Mills (Pty) Ltd., Messrs Lastonet (Pty) Ltd., Messrs Puma (Pty) Ltd. and Messrs Jacques Segard & Co. have become subscribing members to SAWTRI. We extend a hearty welcome to these firms.

Erratum

We would like to draw attention to a small error appearing on page 3 of the

September 1974 (Vol. 8, No. 3) issue of the "Bulletin". In the first paragraph, lines 5 and 6, "Water Affairs Commission" should read "Water Research Commission".

SAWTRI PUBLICATIONS

Technical Reports

No. 234 : Strydom, M. A. and Mountain, F., The Dyeing of Wool with Some Reactive Dyes by a Pad/Bake Method, (October, 1974).

No. 235 : Robinson, G. A., Dobson, D. A. and Green, M. V., A Proposed Method of Assessing the Knittability of a Yarn, (October, 1974).

No. 236 : Silver, H. M., Influence of Dyeing Wool Worsted Yarns on Knittability, (October, 1974).

No. 237 : Hunter, L., The Relationship Between Certain Properties of Wool Worsted Yarns and their Knitting Performance, (November, 1974).

No. 238 : Silver, H. M., Van Heerden, N. J. and Schouten, Pamela, The Simultaneous Shrinkproofing and Dyeing of Wool Fabrics with the Bi-sulphite Adducts of a Polyurethane Resin, a Polyacrylate Resin and Reactive Dyes, (November, 1974).

Papers Appearing in Local and Overseas Journals:

Olivier, De Wet, Recent Research at SAWTRI on the Production of Mohair Blankets, *S.A. Textiles* (December, 1974).

Veldsman, D. P., Drycleaning and Dimensional Stability of Garments, *S.A. Laundry and Dry-Cleaning Review,* p.9 (December, 1974).

Veldsman, D. P., Performance Testing, *S.A. Textiles,* (December, 1974).

TEXTILE ABSTRACTS

The Effects of Sewing Variables on Fabric Pucker by A. M. Bertoldi and D. L. Munden, *Clothing Research Journal,* 2, No. 2, 68 (1974).

This paper investigates the effect of top and bottom thread tensions, foot pressure, stitch density, feed-dog height and machine speed on seam pucker in the case of a Lockstitch machine. A machine developed for measuring the degree of seam pucker as well as the excess length of fabric in the seam was used to evaluate the degree of puckering.

It was concluded that, in this specific case, presser foot pressure, machine speed and stitch density had no significant effect on the degree of pucker whereas the degree of pucker increased with an increase in the needle thread tension. Increased pucker was also observed at extreme settings of the feed-dog height.

Under all conditions of sewing and on all the machines tested the length of the bottom fabric in the seam exceeded that of the top fabric by about 2 *per cent.*

Some work carried out on a two thread chain stitch machine fitted with thread pull-off control showed that "grinning" of the seam occurred with run-in-ratios in excess of 1,1:1 while puckering increased when the run-in-ratio decreased to below 0,9:1. Optimum conditions of the seam, as far as puckering and grinning were concerned, were obtained at a run-in-ratio of 1:1. Run-in-ratio is here defined as the ratio of the length of the top thread to that of the bottom thread.

(L.H.)

ABSTRACTS OF RECENT TECHNICAL REPORTS

No. 234 : The Dyeing of Wool with Some Reactive Dyes by a Pad/Bake Method by M. A. Strydom and F. Mountain

Since the introduction of the first wool reactive dyes in 1952 their use has increased considerably and is now commercially established. Because, however, these reactive dyes do not give complete exhaustion in most cases it is necessary to boil the wool in the dye liquor for long periods of up to 90 min which leads to yellowing and possible damage to the fibres. It was decided, therefore, to establish which type of reactive dye would be suitable for a more rapid dyeing technique for all-wool piece goods by utilising a simple padding/thermal fixation (pad/bake) routine in order that yellowing and possible damage to the fibres might be obviated. A further important consideration was obviously the increase in production rates which such a pad/bake sequence would imply.

The pad/bake method was found to be suitable for the processing of wool piece goods especially when open-width steamers are not available. The process may, however, only be economical for long runs of cloth, since the pre-impregnation procedure requires an intermediate drying process which may add to capital costs if the process is to be continuous. The cost of chemicals however can be kept low owing to the fact that cheap, easy-to-handle chemicals are used in this technique. The highly reactive Procion MX (dichlorotriazinyl) dyes, normally used exclusively for cotton, proved to be ideal for this technique. The dyeings carried out during the investigation were of good colour value and possessed excellent wash and perspiration fastness properties.

No. 235 : A Proposed Method of Assessing the Knittability of a Yarn by G. A. Robinson, D. A. Dobson and M. V. Green

An all-wool yarn was knitted into a Swiss double piqué structure on a 22 gauge Albi-Combirib machine. Settings used commercially were maintained during these experiments except for the Machine Tightness Factor (MTF) which was varied, and the knittability of the yarn was measured at each MTF by counting the number of yarn breaks per 100 000 m of yarn knitted. It was found that the knittability decreases exponentially with an increase in MTF ranging from 13 to 16. The proposed use for knittability of a given yarn entails arbitrarily selecting a breakage rate of 100 breaks per 100 000 m, reading off the corresponding MTF from the graph. The higher this value, the better the knittability of the yarn. As an appendix, breakage rate vs MTF curves for a number of wool/synthetic blend yarns and 100 *per cent* synthetic yarns are given.

No. 236 : Influence of Dyeing on the Knittability of Wool Worsted Yarns by H. M. Silver

All-wool worsted yarns were dyed with acid milling, acid levelling, afterchrome reactive and 1:2 metal complex dyes at concentration levels of 1–5 *per cent* (o.m.f.). The yarns were subsequently knitted on an 18 gauge Wildt Mellor-Bromley machine, and the number of holes formed per 100 000 m of yarn was determined. Each dyed lot was tested for breaking strength, friction and extension. It was established that the latter two factors influenced the knittability of the yarn to a significant extent. Yarns dyed with the 1:2 metal complex dyes had the poorest knitting performance compared with the undyed yarn. The addition of a dyeing auxiliary like Unisol BT improved the knittability of yarns dyed with the acid milling dyes, while the yarns dyed with the other types of dyestuffs exhibited only an improvement in extension when applied in the presence of Unisol BT.

No. 237 : The Relationship between Certain Properties of Wool Worsted Yarns and their Knitting Performance by L. Hunter

A number of wool worsted yarns were knitted into a Punto-di-Roma structure and the number of holes (i.e. yarn breakages) occurring per 1 000 courses was recorded, and related in turn to various physical properties of the yarns. Yarn friction proved to be the most important. It was shown that careful and even yarn lubrication can improve the knitting performance significantly even when employing positive feed. On the average, it was found that by reducing the friction by a factor of 2,81, the average yarn breakages could be reduced by a factor of 39. The other physical properties investigated by applying multiple linear regression analyses, i.e. linear density, breaking strength, extension and irregularity (CV in %) were found to contribute percentagewise much less to the possible causes for an observed number of holes formed during knitting.

No. 238 : The Simultaneous Shrinkproofing and Dyeing of Wool Fabrics with the Bisulphite Adduct of a Polyurethane Resin, a Polyacrylate Resin and Reactive Dyes by H. M. Silver, N. van Heerden and Pam Schouten.

All-wool, plain weave fabric was simultaneously dyed and shrinkproofed by padding through a solution containing the following:

Bisulphite adduct of Synthappret LKF : 10 g/*l*

Primal TR485 (a polyacrylate resin)	:	20 g/*l*
Reactive dye	:	x g/*l*
Urea	:	300 g/*l*
Aerosol OT	:	5 g/*l*

The resins were cured and the dyestuff fixed by steaming the fabrics for 5 min under atmospheric conditions. Residual urea and unfixed dyestuff were rinsed off in a 1% (v/v) ammonia solution at 80°C for 20 min and finally soured by rinsing in dilute formic acid. The samples, washed according to the I.W.S. Test Method No. 185, were found to shrink less than 5 *per cent* in area. The covalent fixation values of the dyes used, the subsequent wet fastness properties and the fastness to light were found to be as good as those of samples dyed by padding with urea, wetting agent and acetic acid alone, followed by batching for 48 hours.

TEMPERATURE AND HUMIDITY IN COTTON PROCESSING : A SURVEY OF RECENT RESEARCH RESULTS

by DE V. ALDRICH

The importance of the ambient atmospheric conditions in the mechanical processing of cotton fibre into yarn is well-known.

The influence of moisture content on *ginning efficiency* and the latter's effect on fibre properties has been investigated by several authors[1, 2, 3, 4].

All spinners are aware of the importance of controlling atmospheric conditions in the spinning department, but they differ widely on what could be considered as optimum conditions. The purpose of this short paper is to bring to the attention of spinners some of the latest results obtained on the influence of atmospheric conditions on mechanical processing efficiency of cotton fibre.

Baril *et al*[5] investigated the influence of temperature and relative humidity on the forces required to separate cotton fibres. It was postulated that the measurement of changes in drafting force of a card sliver could be correlated with the forces required to separate fibres which are in bulk form, as during blowroom processing. The results demonstrated that optimum atmospheric conditions exist for the separation of fibres with minimum force requirements. With increased temperature and relative humidity a consistent and highly significant decrease in drafting force resulted. Above 70 *per cent* relative humidity the decrease in drafting force with increasing relative humidity was no longer significant at any temperature. The amplitude and wave length of the drafting force also decreased significantly with increasing temperature and relative humidity. The authors concluded that operating fibre separating equipment at between 120°F and 138°F and at a relative humidity of between 65 *per cent* and 95 *per cent* will result in a 35 *per cent* to 45 *per cent* reduction in separation force compared with conditions of 75° to 80°F and 50–55 *per cent* relative humidity. The above experiments were part of a programme to develop new techniques for completely individualizing fibres from small tufts, as during the opening and cleaning processes in the blowroom.

Henry *et al*[4] reported that cotton fibres which had been initially damaged by low humidity and high temperature treatments showed even more extensive damage when exposed to harsh mechanical treatment, such as carding and the use of crush rollers at the card. The authors also report that higher relative humidities, 65 *per cent* and above but below the limits of condensation, were found more desirable for least fibre damage. There is a limit, however, beyond which difficulty due to the sticking of fibres to each other and to the machine surfaces occurs.

The optimum twist constant (maximum yarn strength) was found to be relatively constant regardless of humidity during spinning[6]. Smooth curves were obtained for all the cottons and at all the relative humidities investigated except at 65 *per cent* relative humidity when the curves became ragged and inconsistent. A higher minimum twist was also necessary at 65 *per cent* relative humidity to prevent an abnormal high end-breakage rate during spinning. Skein (lea) strength was also found to be nearly proportional to humidity in spinning, but became inconsistent at 65 *per cent* relative humidity.

The surface friction of the fibres readily explains this behaviour. In the region of 65 *per cent* relative humidity the friction increases abruptly(8), which results in irregular drafting or fibre clumping and consequently, loss of yarn strength and an increased end-breakage rate. The authors(6) recommended that spinning should not be attempted at humidities approaching 65 *per cent.*

One of the most extensive investigations into the effect of ambient atmospheric conditions during cotton spinning on yarn properties and spinning efficiency was that of Pillay(7). The results indicate that combinations of –

(i) high temperatures (84–91°F) with low humidities (34 to 48 *per cent*), and

(ii) low temperatures (70°F) with high humidities (62 to 76 *per cent*),

adversely effect end breaks during spinning.

Under conditions of high temperatures and low humidities lack of cohesion between fibres in the roving and its consequent rupture in the spinning zone may be the cause of the end breaks. This argument does, however, not agree with the findings of Baril *et al*(5), who reported high temperatures and high humidities required for the separation of fibres with minimum force.

In the second case (low temperatures and high humidities) sticking of the fibres to the machine surfaces, the increased friction between traveller and ring, and increased inter-fibre friction (irregular drafting) may cause end breaks.

Pillay(7) reported that optimum conditions for spinning efficiency (minimum end breaks) are 70 to 77°F and 41 to 48 *per cent* relative humidity. If, for any reason, these conditions cannot be met, some benefit could still be obtained by selecting appropriate humidities for existing temperatures. For temperatures below 80°F, 41 *per cent* relative humidity may still be used, whereas at temperatures above 84°F higher levels of relative humidity (62–76 *per cent*) is the most suitable.

At high temperatures (84 to 91°F) the response of different cottons to the same humidity level also appears to be different. Short to medium length cottons require higher humidities than long to extra long cottons to give the lowest number of end breaks.

It was also reported that the *per cent* change in end breaks with twist and spindle speeds are higher at higher temperatures than at lower ones. Similarly for draft they decrease with increase in relative humidity.

Pillay also investigated the effect of ambient spinning conditions on yarn properties. Tensile properties of the yarns were measured under spinning room conditions and standard laboratory conditions.

The results indicate that maximum yarn lea strength under conditions in the spinning room was obtained when the yarns were spun at a relative humidity of 76 *per cent*, and temperature of 70°F. When these yarns were allowed to condition to standard laboratory conditions and then tested, maximum yarn lea strength was obtained when the spinning conditions were high relative humidity (76 *per cent*) and high temperature (91°F). Maximum yarn elongation at break (when measured under standard conditions) was obtained when the yarns were spun at the lowest temperature (70°F) and humidity (34 *per cent*). Increases in relative humidity from 34 *per cent* to 76 *per cent* in the spinning room resulted in an increase in lea strength of about 8 to 9 *per cent* (depending on the cotton) under standard conditions.

One would expect the strength of the yarns to be the same irrespective of spinning room conditions especially after the samples were dehumidified and conditioned at a standard laboratory atmosphere. The persistence of differences between the strength of yarns spun at varying temperatures and humidities after conditioning in a standard laboratory atmosphere seems to imply that basic changes in yarn structure had taken place during spinning at high relative humidities and temperatures.

Thick and thin places, and neps showed no definite tendency to increase or decrease with temperature or relative humidity of the spinning room. The most even yarns were spun at 62 *per cent* relative humidity, irrespective of temperatures.

In summing up the results of Pillay, it is interesting to note that the conditions giving maximum lea strength of the yarns, corresponds to the conditions which gave rise to maximum end breaks. To get maximum yarn strength under standard laboratory conditions, the yarn should be spun at the highest levels of temperature and relative humidity. Unfortunately however, these conditions not only encourage maximum end breaks but are also particularly uncomfortable for working personnel. A compromise is, therefore, necessary as far as yarn quality, end breaks, and work personnel are concerned. Pillay recommends the following:

(i) 69 *per cent* relative humidity and 84°F for coarse and medium counts, and

(ii) 62 *per cent* relative humidity and 84°F for fine counts.

The choice of conditions will, however, also depend on whether *maximum productivity* or *maximum yarn strength* is emphasised in the particular mill.

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SOME OBSERVATIONS ON THE PROCESSING OF POLYESTER/ACRYLIC INTIMATE BLENDS

by D. W. F. TURPIE and G. A. ROBINSON

ABSTRACT

The influence of different preparatory procedures during gill blending of various ratios of polyester and acrylic staple fibre on spinning performance and streakiness was investigated. The best procedure so established was followed in the production of some further yarn for weaving trials. The 30% polyester/70% acrylic blend produced the weakest and most irregular yarn and performed worst in weaving. The 50% polyester/50% acrylic blend performed well during weaving and there appeared to be little to be gained by increasing the polyester content to 70 per cent.

KEY WORDS

Polyester/acrylic blends – gilling – spinning – weaving.

INTRODUCTION

Twenty-five years ago the blending of fibres of different properties was comparatively new. Small percentages of nylon (10% or 15%) were blended with the well-established fibre viscose to give better weaving and wearing performances. Nylon has been superceded by polyester and blends of polyester/viscose have become commonplace in the worsted manufacturing trade. Polyester/wool blends have been very popular for years and currently fabrics produced from polyester/acrylic blends have also become extremely popular. However, there appears to be very little published work on Polyester/Acrylic blends. Du Pont[1] in their Technical Information Bulletin give recommendations for sizing, drawing-in and loom settings for weaving Dacron (Acrylic) and Dacron blends. Merrill[2] discussed the development, properties and applications of Zefran (Acrylic)/Fortrel (polyester) intimate blends in both yarns and piece dyed fabrics. Procedures, set-up and cautionary remarks on 50% Acrylic/50% Kodell 211 (polyester) blends for knitting are given in a report by Eastman Chem. Prod. Inc.[3]. Sheopori[4] discussed the physical properties of various combinations of blends and Merrill[5] claimed that Fortrel 461 was the proper polyester fibre to blend with acrylic to give good handle, with reduced snagging and blow-through for knits.

SAWTRI was invited to investigate the blending of polyester fibre and acrylic fibre to determine the optimum processing and the optimum blend to give acceptable fabric performance at acceptable production rates. This report deals with preparation and spinning performance, fabric streakiness, some yarn characteristics and weaving performance observed in the production of fabrics from various blends of polyester and acrylic.

EXPERIMENTAL PROCEDURE AND RESULTS

Two series of experiments were carried out, in both of which polyester (Trevira type 330 – a medium pilling type) tops and Acrylic (Orlon) tops were used as raw material. The object of the first series of experiments was to investigate the influence of different preparatory procedures on spinning performance and on fabric streakiness. Having established the best preparatory procedure it was the object of the second series of experiments to note the performance of various blends of these fibres, which had been prepared according to this procedure, up to the woven fabric stage.

FIRST SERIES

The first series of experiments was carried out in three stages and to facilitate subjective assessment of streakiness the polyester component was dyed red and the acrylic component was dyed blue before blending commenced.

After dyeing, these tops were dried and then gilled twice on an N.S.C. autoleveller gill box to ensure an even distribution of shade, satisfactory sliver levelness and the selected sliver linear density.

Stage 1 : Pin Density:

In *stage 1* an assessment was made of optimum pin density during gilling by visual assessment of the gilled slivers. All experiments in stage 1 were carried out on a 50:50 blend.

Five slivers of each of the polyester and acrylic, each having a linear density of 18 ktex were arranged alternately at the input of an N.S.C. intersecting gill box and subjected to a draft of 7. 0,4% Leomin KP (Hoechst) was applied during the first gilling. Two further gillings on the same machine were imposed using 7 doublings and a draft of 7 in both cases. This procedure was repeated using three different pin densities of the fallers, namely 5,3, 6,7 and 8,3 pins p.cm and the thrice-gilled slivers compared subjectively for streakiness. No differences could be detected and it was accordingly decided to proceed to stage 2 using the middle choice, namely 6,7 pins p.cm.

Stage 2 : Gill Blending:

In *stage 2* the pin density established by stage 1 was used and an assessment made, by spinning and knitting trials, of the number of gillings required for optimum performance. Two different sliver linear densities were used. The experiments were again carried out using a 50:50 blend.

Eight experiments were conducted during stage 2. Either one, two, three or four preparatory gillings were imposed prior to drawing and this procedure was repeated using two different initial sliver linear densities. In all experiments ten doublings were used for the first gilling operation and 0,4% Leomin KP applied. Seven doublings were used for all successive gillings. A draft of 7 was used throughout the preparatory processes.

In all cases drawing was accomplished in two operations on intersecting gill boxes followed by one operation on a double apron high draft rover. Adjustments to the draft were made during the first operation to eliminate differences due to the two different initial sliver weights. Spinning of 28 Tex Z500 yarns was performed on a double apron Rieter worsted spinning machine at 9 000 r/min on 15 spindles, and end breakages recorded over a period of 2 hours. In each case the yarns were spun on an empty tube starting at the lowest point and the counting of end breakages commenced thirty minutes later. End breakage results and yarn irregularity are given in Table I.

TABLE I

END BREAKAGE RESULTS AND YARN IRREGULARITY AFTER DIFFERENT PREPARATORY PROCEDURES

	End breaks per 100 spindle hours	Irregularity (CV in %)	Neps per 1 000 m
Gill Blending – 24 ktex sliver			
One gilling	3	13	56
Two gillings	3	14	42
Three gillings	3	14	46
Four gillings	7	14	77
Gill blending – 18 ktex sliver			
One gilling	7	14	64
Two gillings	0	14	54
Three gillings	0	13	44
Four gillings	0	14	60

The results given in Table I show that when slivers of a lower initial linear density were used for gill blending, end breakage results tended to be slightly improved. On examination of the two sets of results two or three gillings appeared to be adequate and resulted in the least neppiness.

After steaming, winding and waxing the yarns were knitted into socks of about one metre in length on an 89 mm (3½") diameter Lawson Model FAK 22 gauge circular knitting machine. Several examiners were asked to evaluate the fabrics for streakiness. They reported that it was extremely difficult to detect any major differences between the fabrics. The majority expressed the opinion that, by and large, the most satisfactory result was obtained after 3 gilling operations. They could not detect any differences due to sliver linear density. As a result of these findings it was decided to proceed to stage 3 using three gilling operations and a sliver linear density of 18 ktex.

Stage 3 : Lubrication:

In *stage 3*, pin density and preparatory procedures were fixed according to the findings of stages 1 and 2 and an assessment was made, by spinning and knitting trials, of the best lubricant out of four selected and the optimum level of application. Stage 3 was carried out using blends of 70% polyester/30% acrylic and also 30% polyester/70% acrylic.

The lubricants used for stage 3 were Oxitex 40 (Shell), Eutectal (Manuf. de Produits Chimiques), Leomin KP, and Duralcon (Thompson). The lubricants were applied during the first gilling at three different levels of active matter, namely 0,1, 0,2 and 0,4 *per cent* and sufficient water added to bring the total application of water in each case to three *per cent*. In addition, water was used at the level of three *per cent* for the control test. The experiment was repeated for two blend percentages of polyester and acrylic.

The procedure followed for drawing and spinning was the same as in stage 2 and the same linear density of yarn was spun, but the spindle speed was increased to 10 000 r/min.

Spinning performance and yarn irregularity results are given in Table II.

For staple synthetic yarns of about 28 tex spun on the Worsted system, Uster standards[6] show that values to be expected for yarn irregularity are as follows –

	Average yarn	Top 25% of yarn	Lowest 25% of yarns
Irregularity (CV in %)	16	14,3	18,2
Thin places per 1 000 m	40	20	90
Thick places per 1 000 m	14	8	35
Neps per 1 000 m	15	8	30

TABLE II

END BREAKAGE RESULTS AND YARN IRREGULARITY FOR TWO BLEND RATIOS, AND VARIOUS ADDITIVES AT THREE APPLICATION LEVELS

LUBRICANT	% Active matter applied	End breaks per 100 Sp. hrs.		Irregularity (CV in %)		Total number of thin and thick places per 1 000 m		Neps per 1 000 m	
		BLEND RATIO: POLYESTER/ACRYLIC							
		70/30	30/70	70/30	30/70	70/30	30/70	70/30	30/70
Leomin KP	0,1	0	25	15	14	10	8	69	67
	0,2	6	0	14	14	7	12	69	53
	0,4	6	6	15	14	18	14	87	63
Eutectal	0,1	13	0	15	14	7	8	56	40
	0,2	6	13	14	15	8	22	53	66
	0,4	19	13	14	15	7	13	64	55
Duralcon A2	0,1	0	19	15	14	8	8	52	44
	0,2	13	19	15	14	14	15	66	52
	0,4	63	50	15	14	13	12	58	52
Oxitex 40	0,1	13	38	15	15	8	11	56	46
	0,2	38	44	14	14	11	14	81	62
	0,4	50	44	14	15	8	23	74	62
Water	–	6	0	14	15	10	12	42	62

Judging by these standards it may be concluded that all the yarns tested were of superior quality in respect of irregularity and thick and thin places but were of poor quality with respect to neps. The use of an additive at any one of the levels chosen did not affect yarn irregularity. Variability in the results for thick and thin places and neps preclude any conclusion with regard to the effect of additive applications on any one blend ratio save that no tendency could be observed and the variations appeared to be of little consequence. By and large, the acrylic-rich blend produced yarns which tended to be slightly less neppy.

End breakage results given in Table II show that increasing amounts of additive resulted in poorer spinnability, and judging by the performance obtained when using water alone in the control test it would appear that there was little justification for using an additive at all. The acrylic-rich blend appeared to give a slightly better spin, but variability in the results makes this difficult to judge with any certainty.

The same procedure was followed for knitting as in stage 2 and the fabrics examined for streakiness. The examiners reported that it was not possible to detect any differences when the fabrics were subjectively assessed.

SECOND SERIES

Adopting the findings reported in the first series of this investigation blends of polyester and acrylic in *undyed* form were produced by the gill-blending procedure found previously to have resulted in optimum performance and least fabric streakiness. This procedure comprised three gillings operations with a sliver linear density of 18 ktex, a faller pin density of 6,7 pins/cm and an application of 3 *per cent* of water during the first gilling.

Drawing was accomplished in the same manner as previously and 22 tex Z625 yarns were spun on a Rieter H2 spinning frame at 8 500 r/min on 36 spindles. End breakage results recorded over 5 hours, together with yarn properties are given in Table III.

For staple synthetic yarns of about 22 tex spun on the Worsted system, Uster standards[6] show that values to be expected for irregularity are as follows –

	Average yarn	Top 25% of yarn	Lowest 25% of yarn
Irregularity CV (%)	16,5	14,9	18,7
Thin places per 1 000 m	50	28	100
Thick places per 1 000 m	18	12	40
Neps per 1 000 m	18	9	36

TABLE III

END BREAKAGE RESULTS AND PROPERTIES FOR THREE BLEND RATIOS OF POLYESTER/ACRYLIC YARNS

	BLEND RATIO: POLYESTER/ACRYLIC		
	30/70	50/50	70/30
End breaks per 100 sp. hrs.	16	8	14
Breaking strength (gf)	364	402	454
CV of breaking strength (%)	14	13	14
Extension (%)	19	17	17
CV of extension (%)	12	11	9
Irregularity (CV in %)	19,0	18,5	17,5
Thick and thin places per 1 000 metres	54	82	49
Neps per 1 000 metres	8	10	15

From Table III it can be seen that the neps in the yarns were of above average standard, the thick and thin places were about average and the irregularity average to below average. End breakages were satisfactory considering the spindle speed. It is clear that the higher proportion of polyester gave yarns of increased breaking strength and lower extension.

Overall performance of these gill-blended undyed synthetic components was superior to that obtained on the blends previously reported in this investigation, and the yarns produced were commercially acceptable.

Influence of blend ratio on weaving performance:

The influence of the blend ratio (polyester/acrylic) on weaving performance, was studied for two twist levels (450 and 600 t.p.m.) and for three structures (plain, twill and matt). For this purpose another set of three blends was produced, using the same ratios as previously. From these blends yarns were spun to 22 tex Z625 and folded to give R44 tex S450/2 Z625 and R44 tex S600/2 Z625 respectively.

The above yarns were woven on the same loom at 65% RH and 20°C into the three selected structures. Altogether 18 fabric lengths were produced. The plain loom-state fabrics had 18,9 x 17,3 ends and picks per cm, and finished at 150–175 grams per linear metre. The $^2/2$ twill and matt loom-state fabrics had 25,2 and 23,6 ends and picks per cm and finished 225–250 grams per linear metre.

During weaving, the influence of the various blends on the *warp weaving efficiency* was established. All stoppages were recorded and warp weaving efficiency calculated as follows –

$$\text{Warp weaving efficiency} = 1 - \frac{(\text{Lost time due to } \textit{warp faults})}{\left\{\begin{array}{c}\text{Total running time minus all}\\ \text{other lost time}\end{array}\right\}} \times 100$$

Table IV shows the results of the weaving studies carried out to determine the influence of the blend ratio on the warp weaving efficiency.

From the general picture presented in Table IV it appears that the 30% polyester/70% acrylic blend yarns performed the worst during weaving, and that there was little difference between the 50/50 and 70% polyester/30% acrylic blends in respect of weavability.

As was expected, the highest incidence of knot slippage occurred during the weaving of the plain fabric and showed up the weak places.

As far as twist levels were concerned the yarns with balanced twist (approximately) had an average of only 70% of the loom stoppages compared with the yarns of higher folding twist.

TABLE IV

LOOM STOPPAGES DUE TO WARP FAULTS PER 100 M FOR VARIOUS FABRICS

	Warp	Blend Polyester/ Acrylic	Stops due to Knots Slipped	Stops due to Yarn Faults	Total Stops	Warp Weaving Efficiency (%)
Plain Weave	1	30/70	453	24	477	64
	2	50/50	114	49	163	81
	3	70/30	61	61	122	87
	4	30/70	146	125	271	84
	5	50/50	53	93	146	89
	6	70/30	75	37	112	84
2/2 Twill Weave	1	30/70	92	0	92	91
	2	50/50	36	18	54	94
	3	70/30	17	35	52	95
	4	30/70	29	29	58	96
	5	50/50	18	0	18	96
	6	70/30	62	16	78	92
2/2 Matt Weave	1	30/70	18	0	18	98
	2	50/50	53	36	89	94
	3	70/30	0	0	0	100
	4	30/70	30	30	60	94
	5	50/50	0	18	18	99
	6	70/30	0	0	0	100

For warps 1, 2 and 3 R44 Tex S600/2 Z625 yarns and for 4, 5 and 6 R44 Tex S450/2 Z625 yarns were used.

SUMMARY AND CONCLUSIONS

A preliminary investigation of the gill-blending of dyed polyester (Trevira type 330) tops and dyed acrylic (Orlon) tops was carried out to establish the best preparatory procedure in respect of spinning performance and fabric streakiness. It was found that three preparatory gillings prior to drawing gave satisfactory results. The pin density of the fallers used during gilling seemed to be of no importance but a slight preference was indicated for the use of slivers of lower initial linear density.

The use of additives had no effect of any consequence on yarn properties or fabric streakiness but had a detrimental effect on spinning performance with higher levels of application so that their use was actually superfluous.

The procedure which resulted in optimum performance and least fabric streakiness comprised three gillings with a sliver linear density of 18 ktex, a faller pin density of 6,7 pins/cm and an application of 3 *per cent* of water during the first gilling. This procedure was then followed during a further investigation in which the performance of three different blends of undyed polyester and acrylic tops were studied up to the woven fabric stage. 22 Tex Z625 yarns were spun from each blend. These were folded to two folding twist levels, namely S450/2 and S600/2 and then woven into three structures, namely plain, twill and matt.

Results of yarn tests showed that the 30% polyester/70% acrylic blend produced the weakest and most irregular yarn. Weaving performance trials indicated that the 30% polyester/70% acrylic blended yarn performed worst in weaving whilst the 50% polyester/50% acrylic and 70% polyester/30% acrylic performed very well. The 50% polyester/50% acrylic produced a good weaving yarn with a good handle and from a weaving efficiency point of view there is little to be gained by increasing the percentage of polyester beyond 50%. It would also appear as if a balanced folding twist is more acceptable than a highly twisted yarn.

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THE USE OF PROPRIETARY NAMES

The fact that chemicals and fibres with proprietary names have been mentioned in this report in no way implies that there are not others which are as good or better.

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