SAWTRI BULLETIN

SOUTH AFRICAN
WOOL AND TEXTILE RESEARCH INSTITUTE
OF THE CSIR

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PORT ELIZABETH

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EDITORIAL

The ever-increasing cordial relationship between SAWTRI and the Textile Industry is a matter of great satisfaction to the Institute. Tangible proof of this comes from industry in the form of valuable equipment donated to SAWTRI by one of our subscribers. As a result of budget restrictions, the Institute can afford only a limited amount of capital purchases each year. It is therefore with great appreciation that we acknowledge the generous offer of a sample dyeing machine and also gilling and combing equipment by Messrs Tramatex in Butterworth, Transkei. We would like to assure them that this equipment will be put to good use. We are also indebted to Mr W. J. E. Wilson, President of the Textile Federation, and Managing Director of Romatex Fabrics Ltd. for undertaking to arrange for members of the Federation to be alerted to our needs. We are convinced that this kind of practical assistance from industry can only be of great mutual benefit.

INSTITUTE NEWS

Assistant Director Attends International Cotton Test Conference

Dr L. Hunter, SAWTRI's Assistant Director, returned from Europe on February 11th, where, amongst other things, he attended the International Cotton Test Conference in Bremen, West Germany, where he contributed a paper. The conference attracted more than 360 delegates from some 28 countries. Dr Hunter's paper, one of 24 read, summarised the results of some five years' work carried out at SAWTRI aimed at determining and quantifying the effects of various cotton fibre properties on ring- and rotor-yarn properties processed along both miniature and full-scale processing routes.

Dr Hunter, who is also a member of the International Committee on Cotton Testing Methods, attended a meeting of the Committee in Bremen. Among the functions of this committee are the gathering together of international expertise and to examine the complex area of instrument testing of raw cotton. Of great importance is the main objective of the committee which is to establish the most reliable methods and instruments for measuring cotton fibre properties with the view ultimately to approach the International Standards Organisation to standardise such methods.

While in Europe, Dr Hunter also paid visits to textile research organisations and factories in Germany, Belgium, Switzerland and Austria.

SAWTRI Staff Member receives Doctorate

Dr A. P. B. Maasdorp of the Textile Chemistry Department received a Ph.D. degree at the graduation ceremony of the University of Port Elizabeth in December, last year. Dr Maasdorp's thesis, "A study of the Afterchrome Dyeing of Keratin Fibres", is the culmination of research into the absorption of chromium metal by wool during the chrome mordant dyeing process.

On March 25th, Dr Maasdorp left for the United States of America where, in Charlotte, North Carolina, he will be attending the 52nd Annual Research and Technology Conference. He will pay visits to the Southern Regional Research Centre in New Orleans; and a number of textile firms before flying to the United Kingdom, to visit the IWS in Ilkley and Leeds University. On the continent, he will visit various chemical manufacturers as well as the Deutsche Wollforschungs-institut in Aachen, and the Technical University in Zürich before returning home.

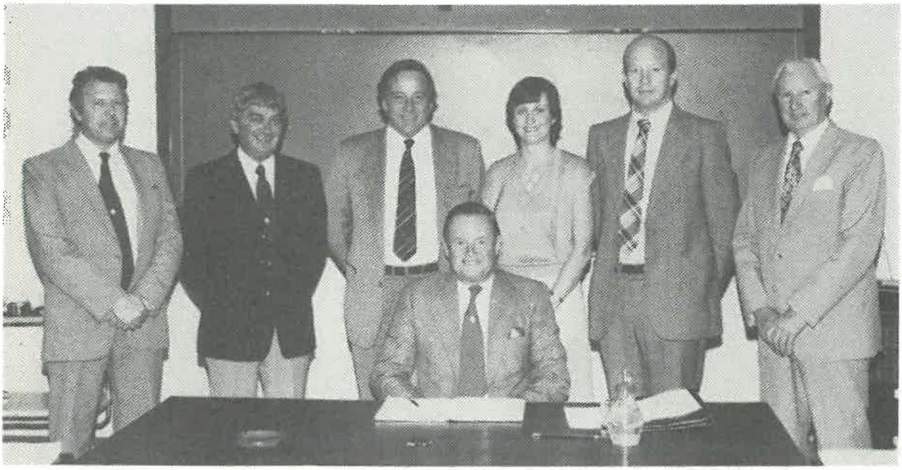
Visitors to SAWTRI

On February 10th, the Director, Dr D. W. F. Turpie, received Mr Wolfgang Tiedemann, of Chemische Fabriek, Grünau GMBH, West Germany, accompanied by Messrs A. Mueck and Joseph G. Nauratil of the firm Texchem.

On February 3rd Mr R. Stroud of Stroud Riley and past President of WIRA paid a visit to the Director.

On December 1st the SAWTRI/Commercial Cotton Growers' Association Research Steering Committee held one of their biannual meetings at SAWTRI. The meeting was attended by the Director, Dr D. W. F. Turpie, Mrs E. Quaile and Mr M. E. Butler the latter two of the Cotton Promotion Council Zimbabwe; Mr R. R. Mc Neil, of the Commercial Cotton Growers' Association Zimbabwe; Dr L. Hunter, Assistant Director of SAWTRI and Messrs G. A. Robinson and N. J. Vogt of SAWTRI and the CSIR Regional Office respectively.

Mr R. Rilling of Hipschburger Machinen GMBH, Reutlingen, West Germany and Mr I. Hensen of Intexma paid a visit to the Institute on February 24th.



The SAWTRI/Commercial Cotton Growers' Research Steering Committee
In the Chair: Mr M. E. Butler
Standing: L to R: Mr G. A. Robinson, Mr R. R. Mc Neil, Dr D. W. F. Turpie, Mrs E. Quaile, Dr L. Hunter and Mr N. J. Vogt

SAWTRI to receive Delegates to International Congress

The International Mohair Association is to hold its annual congress this year in South Africa. These meetings are held alternately in a grower and a manufacturing country. This year the Congress will be held in the Hotel Elizabeth, Port Elizabeth on June 22nd to 24th. On the 22nd June, some 100 delegates will visit SAWTRI for a conducted tour of the Institute. A comprehensive programme of demonstrations and lectures on mohair is being prepared for the visitors.

The 1982 Cotton Symposium

On February 23rd. the Organising Committee of the 1982 Cotton Symposium due to be held on July 27 and 28 this year, met at SAWTRI during which meeting the programme was finalised. Following a meeting last year which was attended also by Mr D. Erasmus and Miss Viljoen of the Cotton Board, it was decided to include a fashion show during the Pre-symposium Dinner on July 26th. A fashion designer from a leading fashion design house, the House of Cronjé Lemmer, will display clothes specially designed for the occasion made from South African manufactured cottons.

The 1982 Cotton Symposium Organising Committee

Seated from left to right: Mr G. A. Robinson, Textile Institute (Vice Chairman), Dr D. W. F. Turpie, Director of SAWTRI (Chairman)
Standing: L to R: Dr L. Hunter, SAWTRI (Assistant Director), Mr N. J. Vogt, (CSIR Regional Office), Mr E. R. B. Ankers, Managing Director of Berg Rivier Textiles and Dr N. J. J. van Rensburg, Textile Institute.
Inset: Mr J. P. de Wit, Vice President, C.S.I.R.

SAWTRI PUBLICATIONS

Since the appearance of the Bulletin in December, last year, the following Technical Reports were published:

No. 487 : Robinson, G. A., Shorthouse, C. M. and Dobson, D. A.: *The Effect of a Loop Control Unit and Take-Down Tension on Knitting Performance and on Interlock Fabric Properties*

No. 488 : Strydom, M. A.: *The Processing Characteristics of South African Mohair, Part I: Long, Medium and Short Good to Average Style Kids, Young Goats and Adults.*

No. 489 : Delaney, P.: *The Bending Properties of Some Punto-di-Roma Wool Fabrics*

No. 490 : Weideman, E. and Robinson, G. A.: *Chemical Modification and Processing of* Phormium tenax *Fibres. Part III: The Effect of Certain Softening Conditions on Fibre, Yarn and Fabric Properties.*

No. 491 : Van der Walt, G. J. H. and van Rensburg, N. J. J., *Foam Finishing. Part 1: Preliminary Trials on the Application of Shrinkresistant Resins to Wool.*

No. 492 : Mozes, T. E., van Rensburg, N. J. J., and Turpie, D. W. F.: *A Laboratory Study of the Interrelationship between Wool Scouring Efficiency and the Partition of Detergent during Subsequent Centrifuging.*

No. 493 : Robinson, G. A., Hunter, L. and Taylor, H.: *Spinning and Weaving of DREF Yarns having Speciality Fibres on the Surface.*

No. 494 : Smuts, S. and Hunter, L.: *The Physical Properties of some Commercial Woven Mohair/Wool Suiting Fabrics.*

A NOTE ON THE EFFECT OF MAGNESIUM CHLORIDE ON THE TREATMENT OF WOOL SCOURING CREAM IN A LABORATORY CENTRIFUGE

by T. E. MOZES

ABSTRACT

A laboratory study of the centrifugal treatment of industrial wool scouring creams has shown that the grease content of the grease phase can be increased significantly and an aqueous effluent phase, virtually free from grease, can be produced by addition of magnesium chloride prior to centrifuging.

INTRODUCTION

Wool grease and lanoline have been recovered from wool scouring creams for many years in wool scouring mills around the globe. The recovery process is normally based on centrifugal separation and has been comprehensively investigated in all its aspects. A review published in 1980[1] lists at least 32 references on this topic.

SAWTRI has been studying the treatment of wool scouring wastes with magnesium chloride[2,3], since this flocculant has been proven to be a very efficient destabilising agent for these wastes. It was therefore decided to carry out a laboratory study to assess its effect on the centrifugal treatment of wool scouring creams.

EXPERIMENTAL

The effect of magnesium chloride was investigated using five industrial cream samples obtained from primary centrifuging of wool scouring liquors. The grease contents of these samples were 21,3% for sample 1; 26,0% for sample 2; 21,3% for sample 3; 25,1% for sample 4 and 36,6% for sample 5. Magnesium chloride addition was varied from 0 to 1% (m/v). Residence time during centrifuging at peak speed was fixed at 25 s (see below) and the temperature at 85°C for all experiments.

The experimental procedure involved addition of magnesium chloride solution (a 20% m/v solution was prepared using magnesium chloride flakes) to the cream, followed by stirring at 80 rev/min while heating to the desired temperature. An aliquot was introduced in a stainless steel centrifuge tube containing a preweighed wire mesh thimble specially designed for lifting the solid grease fraction from the top of the centrifuged cream and the tube was transferred to a laboratory centrifuge. The speed of the laboratory centrifuge was increased to 12 500 rev/min (10 000 G), maintained at this value for 25 s and then allowed to decrease to nil. After centrifuging, the wire mesh thimble was raised and both phases produced, i.e. the solid grease fraction in the thimble and the aqueous effluent remaining in the centrifuge tube, were tested for grease[4].

TABLE 1

RESULTS OBTAINED IN THIS INVESTIGATION

ADDITION OF MAGNESIUM CHLORIDE (% m/v)	SAMPLE 1		SAMPLE 2		SAMPLE 3		SAMPLE 4		SAMPLE 5	
	G_G (%)	G_E (%)	G_G (%)	G_E (%)	G_G (%)	G_E (%)	G_G (%)	G_E (%)	G_G (%)	G_E (%)
0,0	64,2	0,7	63,9	0,8	57,9	0,3	63,9	1,1	62,8	0,7
0,5	83,9	0,1	78,9	0,1	75,8	0,2	78,4	0,1	78,7	0,0
1,0	83,2	0,1	76,6	0,1	72,4	0,2	83,6	0,0	75,9	0,1

G_G — Grease content of grease phase; G_E — Grease content of effluent phase.

RESULTS AND DISCUSSION

The results pertaining to grease contents of the grease (G_G) and effluent (G_E) phases are given in Table I. Quadratic regressions were carried out on this data against the grease content of the original cream sample and the addition of magnesium chloride. The following equations were found to be significant at the 99% level of confidence:

$$G_G = 50,5\,X_1 - 34,8\,X_1^2 + 62,5 \quad \ldots \quad (1)$$

n = 15; R = 0,92; % fit = 85%

and

$$G_E = 1,17\,X_1^2 - 1,78\,X_1 + 0,74 \quad \ldots \quad (2)$$

n = 15; r = 0,87; % fit = 75%

where

X_1 = addition of magnesium chloride (% m/v).

Equations (1) and (2) show that both dependent variables depend exclusively on the addition of magnesium chloride, reaching an optimum at about 0,7 to 0,8% (m/v). The equations also indicate that the grease content of the *grease* phase increased from 63 to 81% with an increase in magnesium chloride addition from 0 to 0,8% while the grease content of the *effluent* phase decreased from 0,7 to less than 0,1%.

SUMMARY AND CONCLUSIONS

A laboratory investigation was carried out to assess the effect of magnesium chloride addition to industrial cream (range investigated 0 to 1% m/v) on the grease contents of the *grease* and *effluent* phases obtained by centrifuging. It was found that the optimum addition of flocculant was about 0,7 — 0,8%. Such an addition of flocculant increased the grease content of the grease phase from 63 to 81% and decreased the grease content of the effluent phase from 0,7 to less than 0,1%.

ACKNOWLEDGEMENTS

The author would like to thank Mrs M. S. Heideman for technical assistance and Mr E Gee and his staff for carrying out the statistical analyses.

REFERENCES

1. Stewart, R. G. and Story, L. F., *WRONZ Technical Papers,* Vol. 4 (1980).
2. Mozes, T. E., van Rensburg, N. J. J. and Turpie, D. W. F., *SAWTRI Tech. Rep.* No. 468 (1981).
3. Mozes, T. E., van Rensburg, N. J. J. and Turpie, D. W. F., *Water, Sewage and Effluent,* 5, 5 (1981).
4. Veldsman, D. P., *SAWTRI Techn. Rep.* No. 5 (1952).

SOME RECENT DEVELOPMENTS IN SPINNING TECHNOLOGY AND THEIR RELEVANCE TO THE WOOL SPINNING SECTOR

by M. A. STRYDOM

Introduction

There has been considerable activity in the development of new technologies for producing staple yarns in the last decade. This is not surprising since it is generally accepted that the limits of classical ring spinning in terms of production rates and productivity have been reached, and alternative methods for increasing production without sacrificing quality have become necessary.

The major efforts have been directed towards the short staple sector, for obvious reasons. It is true to say that few machine manufacturing firms are prepared to make large investments to develop wool-specific systems because of its relatively small share of the market, with the result that the wool spinner has to look to either non-fibre specific spinning systems or to await further possible improvements in ring spinning systems and to attempt to capitalise on developments such as automation. A further disadvantage for the wool spinner appears to lie in the area of consumer acceptability of this new generation of yarns, as it appears almost without exception that the characteristics and appearance of traditional ring-spun worsted or woollen yarn are virtually impossible to reproduce on any of the new technologies. However, it appears that unwarranted consumer conservatism in this respect can in many cases be overcome, since objections on technical, functional or aesthetic grounds can be eliminated by means of a concerted and extensive marketing programme.

There have been a large number of interesting developments in the field of staple yarn production, many of which have been reviewed in depth by Hunter[1]. Although some appear to be nothing more than novel there are some of particular interest to the wool spinner, and these will be discussed very briefly.

The Open-End System

Rotor Spinning

This method of spinning was the first commercial alternative to the ring system and has made a considerable impact on the short staple spinning industry[2]. The input end of the feed sliver is "broken" and twist insertion takes place by means of a rotor. Yarn take-up is onto large packages which reduces doffing time considerably. Although the major application of rotor spinning is for cotton, there is evidence that a number of spinners in Germany and possibly also France are using rotor spinners for wool and wool blends[3].The maximum fibre length determines the rotor diameter, which in turn determines the power requirements. Spinning speeds, depending on yarn linear density, of up to 70 000 rev/min for short wools and up to 100 000 rev/min for short staple synthetics and cotton can be achieved.

Special considerations are required for the efficient rotor spinning of wool, for example special care to avoid exceeding the maximum allowable total fatty matter and vegetable impurities (to reduce rotor clogging) and limitations on fibre length, on opening roller speed and on rotor speed. Whereas the commercial spinning limit for ring spinning is around 45-50 fibres in the cross section, it is at least 100 for rotor spinning, which somewhat limits the finest yarns which can be spun from wool and wool blends of a given mean fibre diameter.

At present the advantages of rotor spinning of wool appear to be limited to the field of woollen-type yarns[4]. Rotor-spun wool yarns appear more hairy and have a crisp handle due to the inherent higher twist levels compared to ring yarns. These considerations preclude them from the more traditional light- to medium weight worsted outlets.

Dref Spinning

The Dref system was developed by the Ernst Fehrer Organisation in Austria and is an open-end system functioning on an essentially friction/aerodynamic principle of yarn formation. As opposed to the rotor system, fibre length is not a limiting factor for high speed spinning and fibre lengths of 20-150 mm can be handled, although there is evidence of considerable fibre breakage[5]. The machine is fed via card sliver and the yarn formation process takes place in the nip of a set of perforated drums rotating in the same direction. The Dref II system can spin coarse woollen-type yarns in the range 200-4000 tex at delivery speeds of 70 to 280 m/min . Because there is very little tension during drawing-off, end breaks are claimed to be very low. End uses of Dref II yarns are in the heavyweight category which include carpets, upholstery and outerwear. Core yarns involving a continuous filament yarn as well as fancy yarns by means of a bouclé attachment can be produced on the Dref II spinner.

A more recent development from Fehrer is their Dref III system which allows finer yarns (30 to 100 tex) to be spun[6]. This system comprises essentially the perforated drum spinning element but in addition it has a small drafting element which delivers a stream of fibres from a drafted sliver into the stream of fibres which are fed onto the perforated drum from the carding cylinder. These yarns are in the fine to medium category, and are essentially woollen in character. Yarn production speeds of up to 450 m/min and package sizes of up to 10 kg, however, make the Dref III system an exciting prospect for the future.

The Self-Twist Spinning System

The only commercial self-twist spinning system which seems to have make any reasonable impact is the Australian CSIRO system embodied by the Repco Type 888 and 891 machines and marketed internationally by Platt Saco Lowell. The Mk I version (Type 888) is a four head unit running at 220 m/min while the Mk II version (Type 891) has a five head delivery and runs at 300 m/min . By means of oscillating rollers, two drafted slivers are false-twisted (or rather temporary-twisted) and allowed to converge with a phase difference. Residual torque then allows the two strands to self-twist around one another[7].The major advantages of self twist spinning are reduced power consumption, increased production rates and a considerable reduction in floorspace requirements. The yarns can be used as is (ST form) for knitting (mainly high-bulk acrylic) or in the uptwisted form (STT) for weaving purposes, the latter most conveniently obtained by means of two-for-one twisting[8]. This can be carried out without prior assembly winding as in the case with conventional ring yarns. A disadvantage of self-twist yarns, however, is that patterning in woven goods become a problem if the ST twist levels are not accurately controlled.

Although originally developed for wool only, the Repco self-twist spinning system today holds a 5% market penetration into the long staple sector,[9] mainly owing to its popularity for producing soft twist high-bulk acrylic knitting yarns. Compared with ring yarns, Repco STT wool yarns have the same tenacity and slightly higher extension and irregularity and recent work at SAWTRI[10] has shown that the weaving performance of these yarns may be adversely affected by breaks occurring at thin places of relatively high twist in the yarn.

The Wrapped (Bound) Spinning System

Wrapped or bound wool yarns contain a small percentage of synthetic filament which, for a relatively expensive fibre such a wool, is an advantage owing to its cost diluting effect. The filament yarn is usually nylon but the use of fine linear density polyester has been studied by SAWTRI for certain end commodities such as hosiery[11].

The Repco self-twist spinner features prominently in two wrapped spinning systems. The Repco Type 892 Selfil spinner is a modified Repco Type 891 which allows two strands of filament yarn to be wrapped around a single wool strand in such a manner that regions of zero twist (i.e. weak areas) in the composite are eliminated[12]. On the other hand, the SAWTRI Repco-Wrapped

Core-Spun technique (RWCS) involves a Standard Repco Mk I (Type 888) and also makes use of two fine multifilament threads; one thread forms the core of the composite and the other acts as a wrapper. Very fine yarns can be produced by this technique which have sufficient tenacity for weaving purposes as well as the good extension properties required for knitting. SAWTRI has shown that by suitable selection of raw materials (fine wools and mohair in particular) relatively fine yarns can be spun quite satisfactorily and although slightly more irregular than ring yarns, are eminently suitable in the STT form for both lightweight knitted and woven constructions.

Filament wrapping of a strand of staple fibres is also the fundamental yarn formation concept incorporated in the Leesona ®Coverspun and the Suessen ®Parafil 2000 systems. This concept differs from the Repco wrapped systems in the sense that no twist of the staple component is involved. The minimum staple length requirement is around 60 mm and delivery speeds of yarns from 20 tex to 500 tex of up to 320 m/min are possible. The staple fibre component is delivered via the front roller of a conventional three, four or five roll drafting system to a vertical hollow spindle onto which the filament spool is mounted[13]. The spool/spindle component rotates at speeds as high as 45 000 rev/min, thereby wrapping the staple fibre strand and thus forming the yarn. End break frequencies of only 20% of ring spun levels have been claimed, with the added advantages of a reduction in labour costs (larger take-up packages and hence less doffing) and lower power consumption. Due to its untwisted structure, apparel fabric aesthetics and physical characteristics may differ slightly from those of their ring-spun counterparts. The yarn is said to be more voluminous and hence better covering, smoother, and equal or better in tenacity, elongation and regularity than ring yarns. This type of yarn should therefore be very suitable for velours and plush fabrics.

The Core-Spinning System

The spinning of a staple yarn with a synthetic filament core can be carried out on both the open-end and the ring spinning systems. However, such methods are not very common for wool yarns and the only entirely new technology in this field appears to be the recently introduced ®Novacore RS 200 system of ARCT Roanne[14]. The system operates on the self-twist principle and involves the two synthetic filament cores which are fed into a strand of conventionally drafted staple fibre. The staple fibre is wrapped around the core and a special twist variation device creates alternating S and Z twist which in turns allows two ends to self-twist, forming a two-ply core-spun yarn.

The advantages claimed for this system include a high machine output (150-220 m/min) and a very low spinning limit (15 to 18 fibres in the cross-section). The yarns are apparently stronger and more even than ring yarns (owing to the core) and torque-free, which is an advantage for knitting purposes.

The Ring Spinning System

Although all the major new spinning systems have been developed as a result of ring spinning having reached its limits in terms of production rates, the situation in this area has not remained entirely static. Machine manufacturers realise that ring spinning is a well-established and a well-known technology and that its versatility will, for the foreseeable future, allow ample supply of yarn in virtually all sectors of the market. As a result, a certain amount of research activity, although perhaps at a relatively low-key level, can be discerned in this traditional area of long staple spinning.

Attempts have been made to eliminate the limitations on production rates brought about by the maximum attainable traveller speed by introducing the rotating ring principle[15]. This principle allows the relative motion between ring and traveller to be reduced, hence ring- and traveller wear are minimised which in turn allows spinning speeds to be increased to as high as approximately 20 000 rev/min . The disadvantages of this system includes a possible doubling of investment per spindle, more stringent maintenance requirements and increased labour costs as a result of more frequent doffing. Although cost benefits of the rotating ring system for the wool spinner is therefore, in general, not all that clearly discernible at this stage, several firms appear to be quite active in this field[16].

A further disadvantage of classical ring spinning is the small package size and its related labour intensive character in terms of doffing and end break piecening. Since the size of the package is limited by the size of the ring, research has been directed mainly towards automation of the doffing process. Automated doffing and piecening equipment are currently available but these are still relatively expensive. On the other hand, a reduction of end break-frequencies would not only minimise labour costs but would also improve yarn quality and this is currently also possible with computer-assisted data collection and analysis systems such as the Uster ®Ringdata system[17].

One of the more exciting development on the ring-spinning scene in recent years has been the introduction of the ®Sirospun process[17]. Sirospun is a means of spinning a "two-fold" worsted weaving yarn directly from a single spinning position. Two strands are drafted by a single drafting zone and allowed to converge above the yarn twizzle. Although this principle has been used for many years in jaspé (grandrell) yarn production, these formed essentially a singles yarn and the problem arising when one strand breaks has been solved by the patenting of a so-called "break out" device which is installed between the twizzle and the yarn convergence point. This device prevents a length of singles yarn to be wound onto the tube by breaking the second strand a few seconds after the first has broken. The yarn characteristics appear to be somewhere between those of a double-rove yarn and those of a conventional two-fold yarn. Sirospun yarns are usually spun with S-twist to comply with weaving requirements. The advantage of Sirospun is that assembly winding and twisting are eliminated and a doubling of the production rate per spindle is achieved. The yarns are twist lively and less hairy than a conventional singles yarn, and depending on twist they tend to be slightly more irregular and more extensible, with strength virtually the same[18]. A disadvantage of Siropun yarns is that their application appears to be restricted to the weaving sector only at this stage. The most serious disadvantage of Sirospun yarns, however, is the extensive increase in two-ply knot frequency (as a result of a single clearing and winding operation from spinning packages with no additional folding prior to weaving), and the performance of these knots during preparation and weaving. Knot slippage is a major problem as a result of the less hairy nature of these yarns, but splicing appears to afford a solution.

Summary and Conclusions

It appears that the current state of the art of worsted spinning is heavily in favour of classical ring-spinning to maintain the major share in this area for the foreseeable future. However, the situation is by no means static and significant changes should take place since certain of the new technologies are bound to take over certain specialist areas of the market. Nevertheless ring-spinning appears to be here for many years to come.

REFERENCES

1. Hunter, L., *Text. Prog.* **10** (1/2), 1978.
2. Guse, R., Promoli, J. C. and Schuon, G., *Melliand Textilberichte Int.* **59** (4), 265 (1978).
3. Landwehrkamp, H., *Text. Res. J.* **49** (3), 137 (1979).
4. Arzt, P. and Bausch, A., *Int. Text. Bull (Spinning)* **1**, 97 (1977).
5. Hunter, L., Gee, E., Spencer, J. D. and Taylor, H., *SAWTRI Techn. Rep.* No 642 (1980).
6. Fuchs, H., *Melliand Textilberichte Int.* **60** (8), 638 (1979).
7. Henshaw, D. E., *Self Twist Yarn, Merrow Publishing Co.,* (1971).
8. Anon., *Can. Text. J.* **93** (8), 62 (1976).
9. Henshaw, D. E., *Australasian Text.* **1** (1), 10 (1981).
10. Hunter, L., Gee, E. and Smuts, S., *SAWTRI Techn. Rep.* No 477 (1981).
11. Robinson, G. A., *et al,* Unpublished results.
12. Walls, G. W., *Text. J. Aust.* **50** (8), 9 (1975).
13. Caban, C. J., *Text. Res. J.* **49** (3), 146 (1979).
14. Dupeuble, J. C., *Chemiefasern/Text. Ind.* **30** (11). E101 (1980).
15. Lord, P. R., *Text. Month,* p. 73 (June 1980).
16. Anon., *Text. Month,* p. 55 (Dec. 1979).
17. ®Uster Ringdata Handbook.
18. Morgan, W. V., *IWS Text. Eng. & Process Techn. Inf. Newsletter* **2** (Nov., 1981).

A NOTE ON THE INFLUENCE OF THE ACCURACY OF MEASUREMENT ON THE SLOPE OF A REGRESSION LINE

by E. GEE

INTRODUCTION

Often the calculated regression line is criticized because it is very different to the line one would have drawn by eye. It is well known in fact that the best line drawn by eye through the data points has a greater slope than the calculated regression line of y or x (see Fig 1). This is because the calculated line assumes that the x-values are measured with greater accuracy or reproducibility than the y-values, i.e. $\sigma_x << \sigma_y$, whereas the line drawn by eye assumes equal accuracies for x and y. The following considerations illustrate the influence of the accuracy of measurement x and y.

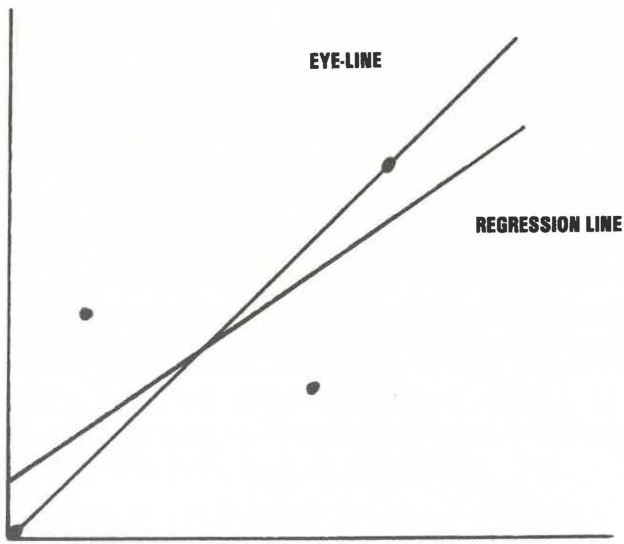


FIGURE 1

Illustration of the calculated line and the line "judged by eye"

DISCUSSION

TABLE 1

HYPOTHETICAL DATA

x =	3,	4,	5,	8,	7,	5,	6,	3,	7,	5,	6,	4,	8,	6
y =	3,	6,	7,	8,	5,	5,	8,	5,	7,	3,	6,	4,	6,	4

A plot of a hypothetical selection of the data points shown in Table 1 is given in figure 2. The "best line" drawn by eye judgement is that represented by the relation $y = x$. The simple regression of y on x calculation gives $y = 0{,}55\ x + 2{,}5$. These lines are also shown in Fig 2 as is the regression of x on y.

It is instinctively felt that the relation $y = x$ is the best representation of this data and it is so if the x-values are measured with the same inaccuracy (or accuracy) as are the y-values.

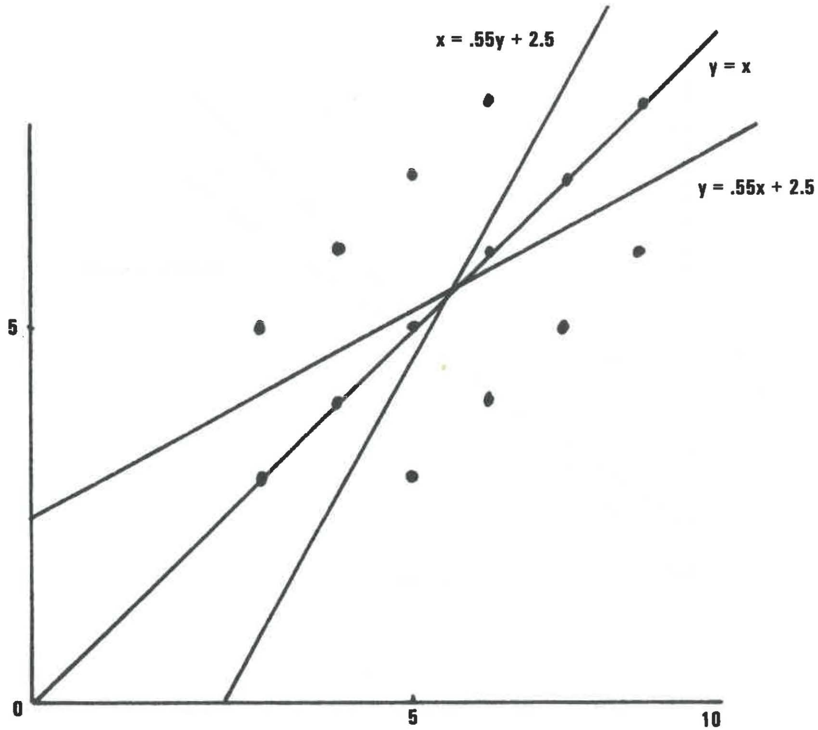


FIGURE 2
Plot of hypothetical data points

TABLE 2

REARRANGED DATA VALUES

x =	3,	3,	4,	4,	5,	5,	5,	6,	6,	6,	7,	7,	8,	8
y =	3,	5,	4,	6,	3,	5,	7,	4,	6,	8,	5,	7,	6,	8

If the experiment from which these values were obtained was such that x was set or measured with great precision e.g. a temperature setting, and that y was imprecisely measured then the data of Table 2, which is merely a re-arrangement of Table 1, should be regarded as representing only six valid points for a graph namely x = 3, 4, 5, 6, 7 and 8, y = average of y at each x. These are shown in Table 3

TABLE 3

VALID POINTS FOR REGRESSION

x	=	3	4	5	6	7	8
y	=	4	5	5	6	6	7

The line drawn by eye through these points would just about correspond with the calculated regression line.

To summarise, if $\sigma_x = \sigma_y$ we obtain the best "eye" line whereas if $\sigma_x << \sigma_y$ we obtain the standard regression line

The influence of the ratio of σ_y to σ_x on the calculated regression line is considered below.

When $\sigma_x << \sigma_y$ then $y = a_1x + a_0$

Where $a_1 = \dfrac{XY}{X}$, $a_0 = \bar{y} - a_1\bar{x}$ and $r^2 = \dfrac{(XY)^2}{X.Y}$

and X, Y and XY are the usual expressions such as $X = \Sigma x^2 - (\Sigma x)^2/n$.

The more general case which places no restriction on σ_x and σ_y uses the following relations[1]:

Regression line is $y = \bar{y} + b\,(x - \bar{x})$ or $y = bx + b_0$

where $b = m + \sqrt{m^2 + k^2}$

and $k = \sigma_y/\sigma_x$

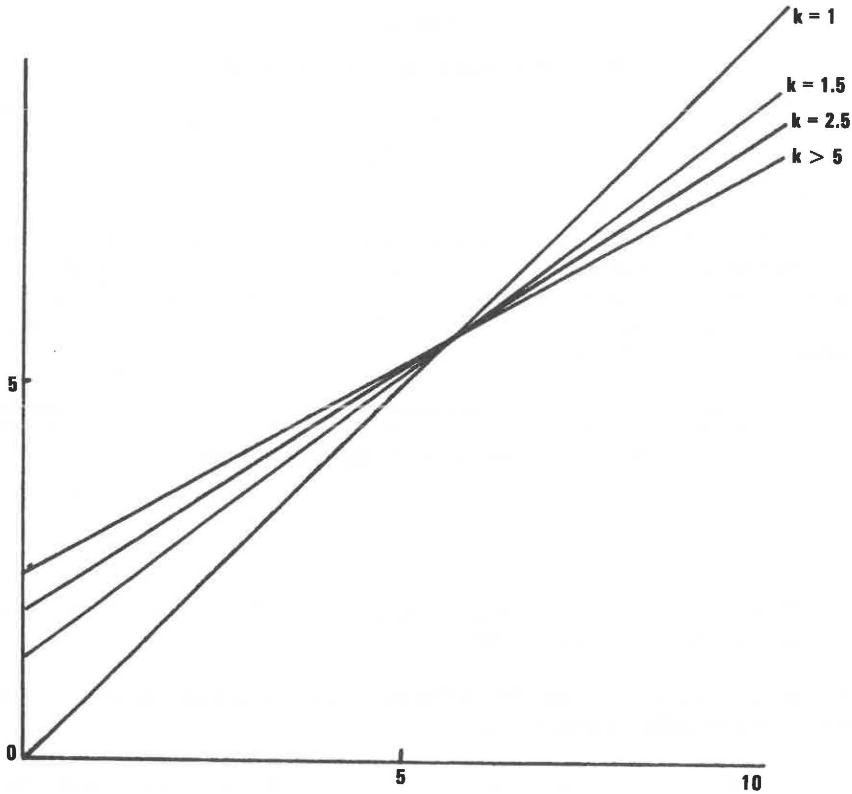


FIGURE 3
Regression line for the x-variable measured with different accuracies

and $m = \dfrac{Y - k^2 .X}{2.XY}$

For the above data in Table I it follows that —

$$Y = X = 35{,}5;\ XY = 19{,}5;\ \overline{x} = \overline{y} = 5{,}5; \qquad n = 14$$

Consider various values for k, say from 1 to 20, i.e. from $\sigma_y = \sigma_x$ to $\sigma_y = 20\,\sigma_x$.

Calculation gives values for b and b_0 as shown in Table 4.

TABLE 4

CALCULATED REGRESSION LINES FOR DIFFERENT VALUES OF k

k	b	b_0
1	1	0
1,5	0,75	1,4
2,5	0,61	2,1
5	0,57	2,4
10	0,55	2,5
20	0,55	2,5

These lines are illustrated in Fig. 3.

If $\sigma_x = 0$ for the original data above then σ_y, derived from Table 2, is $\sqrt{3}$ which corresponds to a CV of 31,5%.

Now, the data set used here was especially selected for purposes of illustration. Practical data are more random and these influences cannot be as clearly considered. However, if one is able to make a reasonable assumption that $\sigma_y > 5\ \sigma_x$ then the usual regression calculation will give a realistic relation.

REFERENCE

1. Davies, *Statistical Methods in Research and Production,* P. 173/4, Oliver and Boyd 1957, 3rd edition.

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