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SAWTRI BULLETIN



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SOUTH AFRICAN
WOOL TEXTILE RESEARCH INSTITUTE
OF THE CSIR

P.O. BOX 1124
PORT ELIZABETH

VOL. 14

JUNE, 1980

NO. 2

SAWTRI BULLETIN

Editor: P. de W. Olivier

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SOUTH AFRICAN
WOOL AND TEXTILE RESEARCH INSTITUTE
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SA ISSN 0036-1003

P.O. Box 1124
Port Elizabeth

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Dr N. J. J. van Rensburg

M. A. Strydom

INSTITUTE NEWS

The 1980 International Wool Textile Research Conference

Every 5 years for the past 25 years an international conference of world renown has been held on wool textile research, each time in a different country. Previous conferences were held in Australia, England, France, the United States and the last conference was held in West Germany in 1975. Now in 1980, by request of the International Committee, this important Conference will be held in SOUTH AFRICA, and will feature not only the latest research findings on wool, but also on mohair and blends. Some 250 scientists from more than 20 countries will be attending the conference. Since SAWTRI in PORT ELIZABETH plays the major role in textile research in Southern Africa it has been heavily involved in the organisation and planning of the conference, and her scientists will be featuring prominently. Of the 150 papers to be presented by research scientists from all over the world, scientists from SAWTRI will be presenting no fewer than 16.

SAWTRI's Director, Dr D. W. F. Turpie, will present 3 papers, one of which deals with a new worsted comb developed at SAWTRI, while the other two deal with scientific studies elucidating the processing performance of typical wools grown in South Africa and the importance of the various wool fibre properties in determining processing performance.

SAWTRI's Assistant Director, Dr L. Hunter, is one of 10 prominent international speakers who are to present plenary lectures on various aspects of wool and mohair research. He will also read 3 other scientific papers dealing with the important field of the relationship between wool and mohair fibre and yarn and fabric properties.

Other SAWTRI Scientists who are authors or co-authors of papers to be read at the Conference are Dr N. J. J. van Rensburg, who is in charge of research on Wet Processing; Mr G. A. Robinson, who is in charge of Fabric and Garment Manufacture; Mr E. Gee, Head of Statistics; Mr E. Weideman, Head of Chemistry; Dr F. A. Barkhuysen, Head of Dyeing; Dr T. E. Mozes, Head of Scouring; Mr S. Smuts, Head of Physics; Mr G. H. J. van der Walt, Head of Finishing; Mr J. Cizek, Head of Machine Development; Mr M. P. Cawood, Head of Clothing Technology and Messrs A. Maasdorp and D. A. Dobson.

We are pleased to introduce to our readers the SAWTRI scientists who are presenting papers at the Conference, together with synopses of their papers.

DR D. W. F. TURPIE

Director of SAWTRI

Educated at Hilton College, Natal. Graduated from the University of Natal with a B.Sc. degree. Managed a firm of wool merchants and topmakers after receiving training in business methods and topmaking in London, Bradford and Switzerland. Joined SAWTRI in 1967 as Head of Carding and Combing. Obtained an M.Sc. (Textiles) degree (cum laude) from the University of Port Elizabeth and in 1974 was awarded a Ph.D. degree by the same University. He became Director of the Institute in 1979 and is also responsible for Worsted Carding, Combing and Spinning. He is a Fellow of The Textile Institute.



The Effect of Raw Wool Blending on Worsted Processing Performance and Yarn and Knitted Fabric Properties

(Co-author: L. Hunter)

The authors summarise the results of 7 years work on the effect of raw wool blending on worsted processing performance and yarn and knitted fabric properties, and conclude that judicious blending of appropriate farmers' lots can be made without unduly affecting their performance under normal circumstances. This indicates that an immediate and substantial reduction in the number of raw wool types marketed is possible.

The Properties and Performance during Topmaking and Spinning of a Wide Range of South African Wools

(Co-author: E. Gee)

The processing results of some 250 lots of raw wool covering a wide range of properties have been analysed. Average values and standard deviations characterising these wools are presented, together with regression equations relating the processing performance during scouring, carding, combing and spinning with the properties of either the raw wool or the top or both. This information could be used in establishing average values for future reference and comparison.

An Introduction to the SAWTRI Comb

(Co-authors: J. Cizek and J. Klazar*)

A novel high-production comb intended for combing fibres on the long staple system has been developed at SAWTRI. A working model of the comb has been subjected to many hundreds of experiments over the past three years. The comb is modular in design and embodies a completely new concept in combing, namely that of continuous linear combing, while at the same time incorporating features of both Noble and rectilinear combing machines. Although its performance has not yet reached its target in respect of percentage noil and top cleanliness, further developments are in progress. An 8 mm movie film of the comb will be presented at the Conference.

DR L. HUNTER

Assistant Director of SAWTRI

Educated at Brebner High School, Bloemfontein. Graduated with a B.Sc. Hons (Physics) degree from Cape Town University in 1964 and joined the South African Wool and Textile Research Institute in 1965. He passed the City and Guilds of London Technician's Final Certificate examinations with distinction in 1969 and was awarded the Worshipful Company of Framework Knitters Silver Medal and the City and Guilds Full Technological Certificate. In 1969, he received his M.Sc.(Textiles) and in 1974 his Ph.D.(Textiles) at the University of Port Elizabeth. He is a Fellow of the Textile Institute. He now holds the position of Assistant Director and is responsible for the Departments of Cotton Processing, Textile Physics, Statistics and Industrial Enquiries.



*ARMSCOR, Pretoria

The Effect of Staple Crimp, Resistance to Compression and Fibre Diameter and Length Characteristics on the Physical Properties of Wool Worsted Yarns
(Co-author: E. Gee)

About 200 wool tops varying greatly in mean fibre diameter, mean fibre length, staple crimp and in resistance to compression were spun into a range of yarns.

All the main yarn properties were related to the various fibre properties by multiple regression analyses. In all, some 200 regression analyses were carried out and some of the most important ones have been tabulated, with certain of the empirical relationships being illustrated graphically.

The Effect of Staple Crimp, Resistance to Compression and other Fibre Properties on the Physical Properties of Knitted and Woven Fabrics
(Co-authors: S. Smuts and E. Gee)

Punto-di-Roma fabrics were produced from 197 wool lots varying greatly in fibre diameter, length, staple crimp and resistance to bulk compression. Cavalry twill-weave fabrics were also produced from 56 of the lots covering a similar range of fibre properties.

The physical properties of the fabrics were measured after finishing and were related to the various fibre properties by multiple regression analyses. The most important regression equations have been tabulated and these quantify the various effects. Important trends have been illustrated graphically. In general, fibre diameter had the most important effect by far on most fabric properties followed by fibre length and resistance to compression (or staple crimp).

The Effect of Certain Mohair Fibre Properties on Yarn and Fabric Properties
(Co-authors: S. Smuts and D. W. F. Turpie)

The effect of mohair fibre length and, in particular, diameter on yarn and 1x1 rib knitted fabric properties has been studied. Within the ranges covered here, the effect of fibre diameter predominated. Statistical analyses were carried out on the yarn results to quantify the various effects. In many cases the trends were similar to those observed previously for wool.

DR N. J. J. VAN RENSBURG

Educated at Steynsrus High School, he studied at the University of the Orange Free State from which he obtained B.Sc., B.Sc.(Hons) and M.Sc. degrees after which he joined SAWTRI in 1962. He obtained a D.Sc. degree in 1966 by the University of the Orange Free State and at present is Group Leader of Wet Processing and Textile Chemistry. He is a Fellow of The Textile Institute.

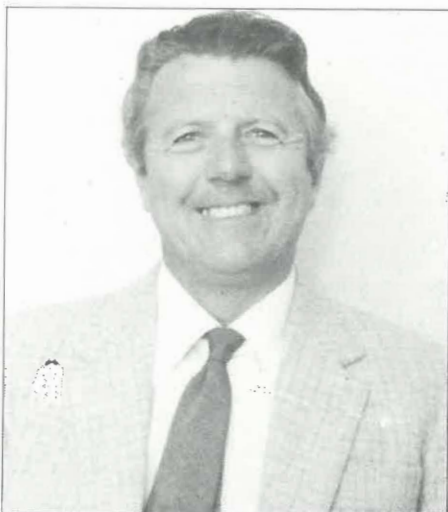


The Shrinkresist Treatment of Wool with Acid Colloid Solutions prepared from Methylolmelamine Resins (Co-author: F. A. Barkhuysen)

It is shown that wool tops and fabric can be shrinkresist treated successfully by chlorination followed by application of an acid colloid prepared from a methylolmelamine resin. The Cl_2 /acid colloid treatment compared favourably with other commercially available processes.

MR G. A. ROBINSON

Educated at Harris College, Preston, Lancashire. Attended Manchester University graduating with a B.Sc. in 1952. He joined SAWTRI in 1967 and obtained an M.Sc. in Textiles from the University of Port Elizabeth in 1970. He is a Fellow of the Textile Institute and Group Leader of Fabric Development and Garment Technology at SAWTRI.



Cockling in Fully-Fashioned Knitwear

(Co-authors: M. P. Cawood and D. A. Dobson)

Cockling is generally associated with localised high yarn linear densities and low plying twist, being worst when excessive short term yarn irregularity allows relatively thick and thin places in yarns to occur at adjacent courses. Even very fine wools if spun to give irregular yarns can cause cockling. Improving yarn evenness by increasing the number of fibres in the yarn cross-section generally reduces cockling. A decrease in crimp showed that relatively low crimp also has a small adverse effect on cockling although mean fibre diameter and the number of fibres/cross-section are of paramount importance in reducing cockling. It is also known that chlorination followed by Hercosett treatment of all-wool knitwear reduces cockling to an acceptable level.

MR E. WEIDEMAN

Educated at Hoër Volksskool, Graaff-Reinet; obtained his B.Sc. and M.Sc.(Chemistry) from the University of Pretoria. Gained industrial experience with Iscor and the Rupert Tobacco Corporation before joining SAWTRI in 1968 where he now is Head of Textile Chemistry.



The Shrinkage of Untreated, Chlorinated and Resin Treated Wool in Organic Solvent-Water Mixtures

(Co-authors: N. J. J. van Rensburg and L. T. van der Walt)

The addition of water to various organic solvents affected the degree of shrinkage of wool fabrics washed therein in different ways. In certain cases the shrinkage of wool was higher in solvent-water mixtures than in solvent or water only. The shrinkage curves of chlorinated and resin treated wool differed from that of untreated wool when washed in various organic solvent-water mixtures.

MR G. VAN DER WALT

Educated at Middelburg (Cape) High School. Received a B.Sc. (Textiles) degree from the University of Port Elizabeth in 1970. He obtained an M.Sc.(Textiles) degree from the University of Port Elizabeth in 1979 and now is Head of Textile Finishing at SAWTRI.



A Study of the Drying of All-Wool and Wool Blend Fabrics by Dielectric and Conventional Heating Systems

(Co-author: N. J. J. van Rensburg)

The amount of energy consumed to dry different fabrics which had been padded with water was determined in a dielectric dryer and a conventional curing oven. In the dielectric dryer the energy consumption and drying energy cost per kg water evaporated increased slightly when the fabric regain decreased, down to a regain of about 15%, below which it increased more rapidly with further decreases in the regain. The dielectric drying energy cost increased when the distance between the electrode plates increased.

A comparison between the dielectric dryer and the conventional curing oven showed that the drying energy cost of the former was lower than that of the latter when drying to regain values higher than 15%.

DR T. E. MOZES

Born in Rumania, he completed his education and received a B.Sc. degree in Chile. He attended the Technion I.T.T., Haifa, Israel, where he obtained his M.Sc. degree in Chemical Engineering. He joined SAWTRI as Head of Scouring and Related Effluent Treatment in 1975. He obtained his Ph.D. from the University of Port Elizabeth earlier this year.



Treatment of Wool and Mohair Scouring Wastes with Bitterns
(Co-author: D. W. F. Turpie)

Five investigations were carried out to assess the potential of bitterns (the magnesium-rich waste residue from a common-salt recovery plant) as a flocculant for grease from industrial wool and mohair aqueous scouring wastes. It was found that high grease removals could be obtained, particularly on effluents and sludges (80 to 95%). Grease removal was significantly correlated with suint, suspended solids, "oxidised grease" and "centrifugally recoverable grease" and with the amount of bitterns added. An addition of bitterns of 5 to 6% (v/v) was found to be optimum in most cases. The effect of temperature was marginal within the range investigated (60 to 90°C).

A pilot scale investigation carried out to evaluate the performance of a horizontal decanter centrifuge on sludges from secondary settling showed that under optimal conditions it was possible to remove 80% of the grease and 92% of the suspended solids and to discharge a solid sludge having a total solids content of 54%.

MR M. P. CAWOOD

Educated at Union High School, Graaff-Reinet. Graduated from the University of Port Elizabeth with a B.Sc.(Textiles) in 1973. He joined SAWTRI's Knitting Department and obtained an M.Sc.(Textiles) degree from the University of Port Elizabeth in 1978 upon which he spent some time at WIRA in the UK. He is at present Head of Clothing Technology at SAWTRI.



Recco Wrapped Core-Spun Wool Yarns in Knitwear
(Co-authors: G. A. Robinson and D. A. Dobson)

The technique of spinning wrapped core-spun (RWCS) yarns on the Recco self twist spinner is described briefly. This is followed by a discussion of

the yarn properties of some fine RWCS wool yarns. The performance of the yarns has been evaluated under commercial conditions by knitting on a 28 gauge double jersey knitting machine and the properties of the resultant fabrics compared with similar fabrics knitted from staple polyester. Furthermore, yarn and fabric properties, as well as the knitting performance of 26 tex RWCS yarns spun on a modified Repco using short wools of differing length and diameter, have been statistically analysed.

MR A. MAASDORP

Educated at Graeme College, Grahamstown, he continued his studies at the University of Port Elizabeth obtaining a B.Sc. (1974), B.Sc.(Hons) in Chemistry (1975) and an M.Sc. (Organic Chemistry) (1976). Spent his National Service doing research on Solid Propellant Chemistry upon completion of which, he joined SAWTRI's Textile Chemistry department in 1979.



The Significance of Temperature and Acid Type on the Exhaustion of Chromium VI onto Dyed and Undyed Wool Fabric

The effect of temperature and acid concentration (pH) and type on the residual chromium concentration in the liquor for dyed and undyed wool fabric during afterchroming, is described. Because of the large number of results and the complexity of the system, a multiple regression analysis was performed yielding six significant regression equations, which, when presented graphically, facilitate interpretation of the uptake of chromium from the dyebath under the different chroming conditions.

A Low Temperature Afterchrome Technique

An alternative afterchrome technique for the chrome mordant dyeing of wool is suggested. This technique incorporates an afterchroming temperature of $\pm 25^{\circ}\text{C}$ followed by a short steaming process. Not only does it save energy and maintain wool quality but it also enhances adequate fastness properties while remaining within the limits laid down for chromium in the effluent.

MR J. CIZEK

Educated in Prague, Czechoslovakia; was trained as an engineer specializing in automation after serving an apprenticeship as a tool design draughtsman. In 1969 he emigrated to South Africa and joined SAWTRI in 1973. He now is Head of Machine Development and Innovation at SAWTRI.



Design and Operation of the SAWTRI Autocreel (Co-authors: J. J. Hasa and J. Klazar)

The article deals with the concept, mechanical design and the design of the electronic control system of a semi-automatic creel for use with gill boxes, draw frames and the like. The SAWTRI Autocreel provides for can change and 'piecing-up', automatically, without the necessity of stopping the machine. Thus the efficiency can be maintained at a very high level.

Director's Visit Abroad

Dr D. W. F. Turpie left South Africa on May 15th to visit the United Kingdom, Ireland, France and Germany before returning on June 18th.

In the U.K. Dr Turpie paid a visit to the S.A. Embassy's Scientific Councillor to discuss matters relating to the recruitment of staff for the Institute. He also paid visits to Wira, the Shirley Institute, the Universities of Leeds and Manchester, the Leicester Polytechnic, Hatra and a number of textile firms. He attended the IWS Research and Development meeting in Ilkley from 21-23 May. In Belfast, Ireland, he held discussions with the Lambeg Industrial Research Association and also visited a textile firm. In Scotland he had talks with Mr Bernat Klein of Bernat Klein Design (Ltd), Galashiels, and with the Principal of the Scottish College of Textiles and visited a number of textile firms. Dr Turpie rounded off his tour with visits to textile firms in France, Germany and Switzerland.

The Director accompanied by the Assistant Director, Dr L. Hunter, Mr G. A. Robinson and Mr J. Vogt, CSIR Regional Liaison Officer, visited Natal textile factories during April. These gentlemen, together with other senior staff members attended the Convocation of the Textile Institute in Durban on April 16th on which occasion both Dr Turpie and Dr Hunter were presented with their Fellowship certificates. The National Wool Growers' Association Congress held in Port Elizabeth was attended by Dr N. J. J. van Rensburg and Mr De Wet Olivier on 15 and 16 April. The official opening was attended by Dr Turpie and Mr Vogt.

Mr Vogt attended the Mohair Growers Association Congress which was held in Port Elizabeth on 4 and 5 June and represented SAWTRI at the Middelburg Agricultural College on the occasion of the official opening of the new main block on June 13.

Since the March issue of the "Bulletin", the Institute received visits from four members of the Natal Cotton and Woollen Mills; three members of the Natal Thread Company and 54 staff members of Messrs Gubb and Inggs.

Another large group, 40 strong, visited SAWTRI on Wednesday, 5 June. This group was made up of members of the Albert Farmers and Wool Growers' Association from Burgersdorp in the Northern Cape.

Members of the Zimbabwe Textile Industry, accompanied by officials with related interests, paid an extended visit to SAWTRI from 9-11 June and had talks with Drs Hunter and Van Rensburg and Mr G. A. Robinson.

On June 5th three businessmen from Japan visited SAWTRI. They were Messrs Futoshi Sugiura, Executive Managing Director of Miyuki Keori Co. Ltd, Nagoya; Mr Shigenobu Kawashima, Managing Director of Nagawa Co., Ltd and Mr Toshiaki Ogura of the same firm. They were accompanied by Mr Peter Lawford of Messrs O. S. Blenkinsop (Pty) Ltd. These gentlemen were in South Africa for the presentation of the Miyuki Keori trophy to the producer of the best mohair clip for the past season.

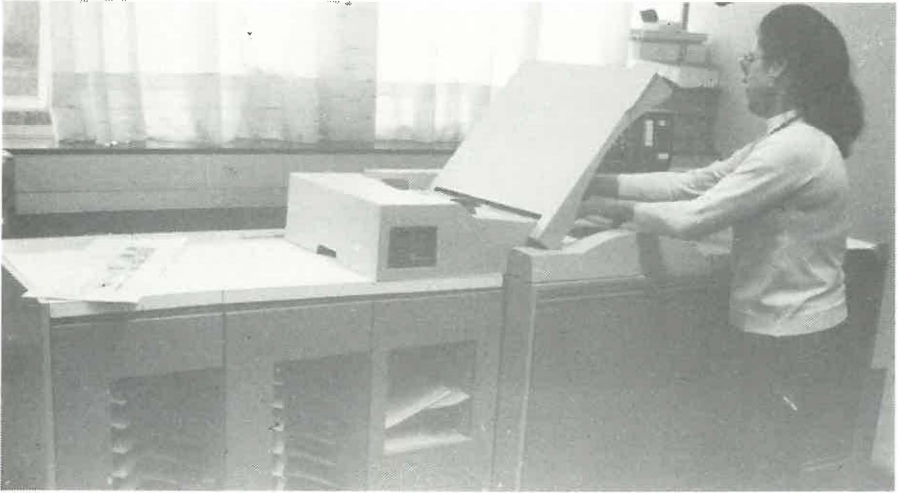


The farmers from Burgersdorp and members of the Albert Farmers' Association who paid a visit to SAWTRI

Dr Miriam Shiloh of Israel who worked at SAWTRI as a visiting scientist in Textile Physics from 1971-1973 returned on May 1st to participate in projects involving the relationship between fibre and woven fabric physical properties. Dr Shiloh returns to Israel on July 8th.

New Appointments

Mr E. Barchietto, formerly of Veldspun and originally from Italy, joined the Finishing Department on June 2nd. He has wide experience in textile finishing and the maintenance of textile finishing machinery.



The new Rank Xerox 7000 duplicating machine recently installed in the Department of Publications and Information



Testing the sewability of a cloth on a "Hattrasew" instrument recently acquired by the Clothing Technology Department

THE QUANTITATIVE ANALYSIS OF A PHORMIUM/POLYPROPYLENE BLEND

by E. WEIDEMAN and S. A. MUSMECI

ABSTRACT

A method is described for the quantitative analysis of a phormium/polypropylene fibre blend. A 40% sulphuric acid solution containing 5% nitric acid is used to dissolve the phormium.

INTRODUCTION

Various attempts have been made at SAWTRI to find new end uses for phormium fibre. It has been shown, for example, that chemically softened phormium can be used in curtaining. Recently some curtaining fabrics were woven from yarns containing a polyester core and a phormium/polypropylene blend¹. The polyester core was later changed to a polypropylene core for economic reasons². During these trials the need arose to determine the composition of blends of polypropylene and phormium fibres.

When a fabric comprising a polyester/cotton warp and a polypropylene/phormium weft is to be analysed for composition the first step is to physically separate the warp and the weft yarns. The warp composition can then be determined by dissolving the cotton in 75% sulphuric acid³. The composition of the weft yarn must then be determined by either dissolving the polypropylene or the phormium fibre. Various solvents will dissolve polypropylene at the boil⁴, viz. tetrachloroethylene, trichloroethylene, tetrachloroethane, amylacetate, toluene, xylene, monochlorobenzene, o-dichlorobenzene and concentrated sulphuric acid. There is a standard method for determining the polypropylene content in binary mixtures with wool, silk, cotton, etc.⁵ which makes use of the fact that polypropylene is soluble in boiling xylene.

In this paper the alternative approach, viz. dissolving the phormium, has been investigated.

EXPERIMENTAL

During preliminary work it was found that 75% sulphuric acid, the solvent normally used to dissolve cellulosic fibres such as cotton and bast fibres does not completely dissolve phormium fibre (a leaf fibre). The addition of an oxidising agent such as nitric acid to the sulphuric acid facilitated the dissolution. Various concentrations of nitric acid and sulphuric acid were evaluated and it was found that an acid mixture of 40% sulphuric acid and 5% nitric acid gave satisfactory results.

Any test based on the dissolution of one fibre from a blend is based on the

fact that the remaining fibre must be totally insoluble or soluble to a very limited extent in the solvent used. Consequently the effect of the above mixture of acids on both fibres was investigated and finally analyses were carried out on a blend of known composition.

Material

Phormium fibre, chemically and mechanically softened¹, and polypropylene (11 dtex) staple fibre were used in this study.

Chemicals

The following laboratory grade chemicals were used:
Dichloromethane, sulphuric acid, nitric acid.

Moisture determination

The moisture content of the fibres was determined in the usual manner.

Pretreatment

The fibres were extracted for one hour in a Soxhlet extraction apparatus with dichloromethane (DCM).

Method

One gram of fibre (or fibre blend), dried and extracted with DCM, was weighed accurately, and placed in a 500 ml flat bottom flask. A solution (100 ml) containing 40% sulphuric acid, 5% nitric acid and 55% deionised water was added to the flask. A double walled condenser was attached to the flask and the contents refluxed for one hour. Water (100 ml) was added to the mixture and the solution was filtered through a sintered glass crucible which had been weighed. The crucible was rinsed three times with 200 ml of hot water and dried overnight in an oven at 100°C. The crucible was weighed again and the percentage phormium was calculated from the mass loss.

RESULTS AND DISCUSSION

The results showed that about 99,5% of phormium was dissolved in a mixture containing 40% sulphuric acid and 5% nitric acid (see Table I).

TABLE I
SOLUBILITY OF PHORMIUM AND POLYPROPYLENE IN A
MIXTURE OF 40% SULPHURIC ACID AND 5% NITRIC ACID

Sample No.	SOLUBILITY (%)	
	Phormium fibre	Polypropylene fibre
1	99,5	0,67
2	99,6	0,63
3	99,6	0,68

From Table I it is clear that the effect of the acid on the polypropylene fibre was negligible, only about 0,7% of the fibre being dissolved. It is possible therefore that the solvent can be used in an analysis of polypropylene/phormium blends and the results of the analysis of blends of the two fibres are given in Table II.

TABLE II
EXPERIMENTAL RESULTS FOR A 50/50 PHORMIUM/
POLYPROPYLENE (NOMINAL) BLEND

% POLYPROPYLENE	
Theoretical	Found (Residue)
45,7	45,8
46,1	46,1
51,0	51,1

SUMMARY AND CONCLUSIONS

A method is described for quantitatively determining the composition of blends comprising phormium and polypropylene. In this method the phormium fibre is dissolved in a mixture of 40% sulphuric acid plus 5% nitric acid.

A blend of phormium and polypropylene fibres was analysed and there was good agreement between the theoretical and experimental values. At the present moment this method cannot be recommended for blends other than polypropylene/phormium.

ACKNOWLEDGEMENTS

Permission by the Department of Industries to publish this report is gratefully acknowledged.

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THE ROLE OF ENERGY MEASUREMENTS IN INCREASED DYEHOUSE PROFITABILITY

by G. VAN DER WALT

ABSTRACT

Equipment is described for measuring the consumption of steam, electricity and water during a dyeing process. A typical example of monitoring a winch dyeing operation involving wool fabric and reactive dyes is given.

INTRODUCTION

As energy costs continue their spiralling inflationary trend, dyers and finishers can expect to feel mounting pressure to reduce their consumption of fuels and other raw materials. The most immediate action which can be taken by industrial consumers is to conserve existing sources of energy in every possible way¹.

Each industry must play its own part in conserving energy and, in the case of the textile industry it is important to (i) look at the present energy consumption and identify those processing areas in which the greatest savings can be made; (ii) decide how to reduce energy wastage in these sensitive areas and (iii) try to predict the implications of energy conservation for the future.

It is essential that dyehouses and finishing plants measure the energy and water consumption and cost for their different machines, as well as for the different textile fibres which are processed. From these values standards can be set and better control of the plant energy requirements can be exercised by comparing the actual energy consumption with the ideal energy consumption. This short communication gives some guidelines as to how this may be carried out.

EQUIPMENT

Steam flow meter*

One piece of equipment which is essential if steam consumption is to be accurately monitored is the steam flow meter^{2,3}. This meter is a differential pressure measuring device operating on the force-balance principle (measuring the rate of fluid flowing in an enclosed pipeline). The installation of the meter is very simple and it can be installed in horizontal and vertical sections of steam pipes having a variety of diameters. The steam flow can be measured in either direction. An orifice plate is installed in the pipe between flanges (Fig 1(a)). Since the orifice is smaller than the pipe, the pressure below the orifice

*SAWTRI has a steam flow meter which can be made available to interested companies.

is lower than that above. The difference in pressure is called differential pressure and is a measure of the rate of flow. The orifice size is important and has to be calculated very accurately prior to installation by using available data such as steam pressure and steam pipe diameter.

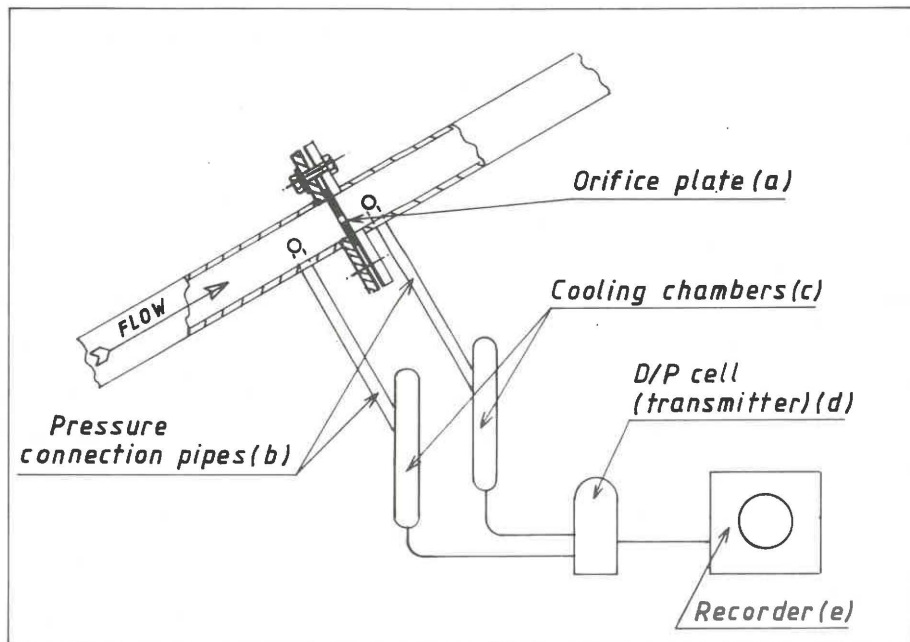


FIGURE 1
Steam flow apparatus

The pressure connection holes (b) located upstream and downstream are connected to cooling chambers (c). From here connections are made to the differential pressure cell transmitter (d) which in turn is coupled to a pneumatic receiver (recorder) with an integrator counter mechanism (e). Recorders with 12- and 24-hour mechanisms are available.

Water flow meter

The water flow meter is installed in the water supply pipeline of the dyeing machine and measures, by means of a counter, the total amount of water consumed for the complete dyeing cycle.

Electricity meter

An ordinary three phase kilowatt-hour meter (3x220V, 50 cycles) can be

used to measure the electricity consumed by the motor during the dyeing process.

RESULTS AND DISCUSSION

A typical example of the energy and water consumption measurement for a dyeing process where 300 kg of wool fabric were dyed with a reactive dye in a winch with a capacity of 6 000 litres is given below. The total dyeing time was 4 hours.

(i) Steam consumption

The steam pressure in the 50 mm pipe was 827 kPa . The steam consumption of the dyeing process was determined as follows:

Heating from 25°C to 100°C required 1 938 kg of steam or 6,46 kg steam/kg fabric

Maintaining the dyeing at 100°C for 60 min required a further 654 kg of steam or 2,18 kg steam/kg fabric

Rinsing at 40°C for 15 min required 240 kg of steam or 0,80 kg steam/kg fabric.

Therefore the total steam consumption was 2 832 kg or 9,44 kg steam/kg fabric.

At a steam cost of 0,40c/kg the steam cost of the dyeing operation amounted to 3,78c/kg fabric.

(ii) Electricity consumption

The electricity consumption of a 3,5 amp motor for 4 hours was 10,35 kWh (based on a power factor of 0,89) or 0,035 kWh/kg fabric.

At a cost of 2,0c/kWh (R5,00 per kVA) the electricity cost was 0,069c/kg fabric.

(iii) Water consumption

The total water consumption of the dyeing process was 18 000 litres, which included the hot and cold rinsing cycles but not an overflow rinsing cycle.

The water consumption per kg of fabric was 60,0 litres and at a cost of 18,0c/m³ of water, the water cost was 1,08c/kg of fabric.

The total energy and water costs for the complete dyeing cycle were found to be 4,93c/kg fabric.

It is, in many cases, possible to use different types of dyeing machines for the same purpose and will machines differ in the energy consumption, for example, when applying disperse and vat dyes to a cotton/polyester fabric, a winch consumed 10,87 kg steam/kg fabric, a jet 9,30 kg steam/kg fabric and a beam dyeing machine consumed 4,35 kg steam/kg fabric. Jones⁴ showed that when a cotton fabric was dyed with direct dyes in a winch at a liquor ratio of

20:1, it consumed 3,65 kg steam/kg fabric against 0,87 kg steam/kg fabric for the same fabric dyed with the same dye in a jig at a liquor ratio of 3:1. In a further example, Russell⁵ gave the energy consumption of different package exhaust dyeing processes. Direct dyes consumed 1,74 kg steam/kg fibre, azoic dyes 2,70 kg steam/kg fibre, vat and disperse (130°C) dyes 4,61 kg steam/kg fibre, reactive dyes of low reactivity 7,39 kg steam/kg fibre and acid dyes consumed 2,26 kg steam/kg fibre.

SUMMARY

It has been attempted by means of an illustrative example involving the dyeing of wool fabric in a winch using reactive dyes, to show how the measurement of steam, water and electricity consumption can provide useful data as a first step in a in-mill energy conservation programme. Such equipment is available at SAWTRI and can be made available to the local industry.

ACKNOWLEDGEMENTS

The author would like to thank Mr D. J. M. Currie of the Department of Machine Development and Innovation for preparing the diagram.

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Published by
The South African Wool and Textile Research Institute,
P.O. Box 1124, Port Elizabeth, South Africa,
and printed in the Republic of South Africa
by Nasionale Koerante Beperk, P.O. Box 525, Port Elizabeth.
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