

SAWTRI BULLETIN



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

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SOUTH AFRICAN
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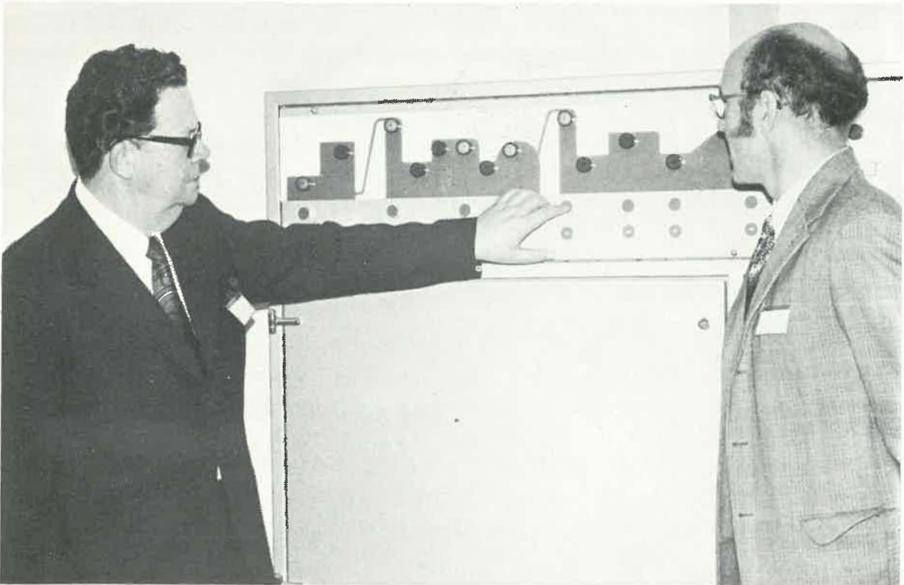
P. de W. Olivier, B.Sc.

INSTITUTE NEWS

Official Opening of New Cotton Processing Division

May 1st was a red letter day in the history of SAWTRI. A long cherished ideal was realised when, in the presence of some 86 invited guests, Dr. C. van der Merwe Brink, pressed the buttons setting in motion the various machines in the new cotton procession division and heralding officially the commencement of cotton processing research under the wings of the CSIR in Southern Africa. A simple act of pressing a button but an immensely significant one since henceforth the interests of a growing cotton industry in South Africa and its neighbouring territories, Rhodesia and Swaziland will be looked after from the scientific research point of view by research scientists of the CSIR who have dedicated themselves to the task of developing the enormous potential of the cotton fibre as a textile raw material to the benefit of seed cotton producers and consumers of the end commodity alike.

In his speech, the President of the CSIR said that, as indicated by its name, SAWTRI, since its inauguration had been concentrating on the processing technology of wool. The necessity for research and development where wool was concerned had been inspired by the appearance of other fibres, especially synthetics during the past three decades and the threat to wool which they represented. Since the CSIR's assumption of responsibility for textile research, it had to, in the light of its broad



Dr. C. van der Merwe Brink, President of the CSIR, pressing the control buttons setting the machines in the new cotton processing division in motion. Looking on is Dr. de Vries Aldrich, Group Leader of Cotton Processing



Scene in the Cotton Processing Division after the Official Opening

national responsibility, take note of the requirements of other fibres produced or which could be produced in South Africa. Dr. Brink said that South Africa was relatively a newcomer in the cotton field but that already production was estimated at more than 200 000 bales. The local processing industry, however, require twice as much. Dr. Brink said that it was the CSIR's function to assist the Department of Agricultural Technical Services in determining which cotton cultivars should preferably be grown to ensure that we produced cotton of desired quality best suited to the requirements of the local manufacturing industry. He said that by commissioning the new cotton processing department, the Institute would now be the only technological research institute which could undertake research and development on all aspects of cotton processing, from the cotton lint stage to the end commodity.

The occasion was utilised by the Regional Office of the CSIR to introduce SAWTRI and its cotton activities to a number of important guests who came from as far afield as the United States, Israel, Swaziland and Rhodesia. The latter was represented by a sizeable contingent made up of members of the Rhodesian Cotton Growers' Association, the Rhodesian Cotton Marketing Board and the Cotton Promotion Council. From Israel came Mr. Dov Becher, a world authority on the mechanical harvesting of seed cotton. Prominent businessmen from the cotton textile industry in Southern Africa were present. The large number of guests was organised into various groups which were shown around the cotton processing and testing departments by senior SAWTRI staff members after which they were entertained to a luncheon held in a large marquee tent erected for the occasion.

Cotton Seminar

A very thought provoking and illuminating seminar was held during the afternoon in the auditorium of the University of Port Elizabeth when some 100 delegates listened to a number of papers read by experts in their particular fields. Mr. J. J. van der Merwe, Assistant Director (Research) of the Transvaal Region of the Department of Agricultural Technical Services, read a paper on Cotton Production in South Africa. Mr. Van der Merwe pointed out that, due to a world shortage of textile fibre, the world price of seed cotton had risen sharply during 1973. The result was an increase in the local price of cotton lint. A substantial increase, it led to a tremendous interest in the cultivation of cotton so that the latest estimate of the present crop stood at 211 000 bales of 200 kg including the Swaziland crop. This, said Mr. Van der Merwe, was double the production of the previous record crop. Mr. Van der Merwe said that he personally believed that there was an excellent future for the cotton industry in South Africa.

Reading a paper on Cotton Grading, Mr. W. Rhodes, Corporate Planning Manager of Messrs. David Whitehead and Sons (S.A.) Limited, focussed the attention on some of those aspects of cotton which determine the suitability for spinning into a satisfactory yarn, recognising the many end uses of both the yarn itself and the finished fabric. The various sectors of the cotton processing industry



Enjoying a friendly chat in the foyer of the Institute on the occasion of the opening of SAWTRI's new cotton processing division are, from left to right: Mr. Heimie Schauder, Chairman of the Midland Regional Research Committee of the CSIR in Port Elizabeth; Mr. Abe Frame, a well-known textile personality who also read a paper at the Seminar during the afternoon and Dr. D. P. Veldsman, Director of SAWTRI



Among the interesting demonstrations of SAWTRI's cotton research, on May 1st, was one illustrating the Institute's successful application of flame retardancy treatment to cotton fabric. In the photograph it can be seen how untreated cotton is being consumed by fire while the treated fabric hardly burns at all

was such that the cotton grader would consider the well-being of not only the spinner, but also that of the weaving and finishing sectors. Mr. Rhodes said that because of this graders have had to expand their knowledge into processing and were therefore becoming more than mere specialists in a narrow field. The graders had established vital interest in all phases of processing and as such played a most vital rôle in the overall well-being of the entire cotton industry.

In a paper on Mechanical Harvesting and Ginning, Mr. John Gordon, Executive Director of Messrs. J. L. Clark Cotton Co. (Pty) Ltd., said that although mechanical harvesting of cotton was gaining ground it should be remembered that of the cotton cultivars presently grown in South Africa, only those originating in the U.S.A. were really suitable for mechanical harvesting. He said that the "African" varieties and locally developed crosses of African and American strains, while providing a fibre highly acceptable to the Spinning Industry, were not as yet really suited to mechanical harvesting. This aspect of the cotton growing industry, in the light of mechanical harvesting and spinner fibre quality requirements, was receiving priority attention by Government and private breeders. Where cotton was being

mechanically harvested, Mr. Gordon said, every effort was being made to ensure that the fibre going into the bale was as nearly similar as possible to what it would have been had it been properly hand harvested.

Also speaking on Mechanical Harvesting, Mr. Dov Becher, Director of the Technical Department of the Cotton Marketing and Production Board in Tel Aviv, Israel, stated that, although machine picking of cotton had spread to many countries in recent years, it had not by any means as yet become the prevailing method of harvesting in the world. He added that only the United States, Australia and Israel have had their harvesting fully mechanised. He said that mechanical harvesting was only beginning to take root in South Africa. He also said that, considering fibre quality, there was not much good to be said for mechanised picking. We have been left, however, with very little choice in view of increasing production costs and shortage of labour. Mr. Becher said that we would have to learn how to make the best of a bad thing as regards fibre quality as affected by mechanisation.

The last paper of the Seminar was read by Mr. A. Frame, Joint Managing Director of the Consolidated Frame Cotton Group Corporation Limited. Mr. Frame said that as the cotton industry was an intermediate processing industry in South Africa the industry was not a trend setting industry but must follow the markets'



Examining some cotton print fabrics on display during the opening of the new cotton processing division at SAWTRI are from left to right: Mr. Neville Vogt, Regional Liaison Officer of the CSIR in Port Elizabeth; Dr. Brink, CSIR President and SAWTRI's Director, Dr. Danie Veldsman



On March 12th the Wool Board took leave of Dr. D. P. Veldsman who resigned from the Board on which he had served for the past five years. Presenting a clock as a token of the Board's appreciation for Dr. Veldsman's contributions to its work is Mr. P. W. van Rooyen, Vice Chairman of the Wool Board

demands and "idiosyncracies". Furthermore, over the last 10 years, spinners, weavers and finishers had continually had to replace outmoded equipment by modern machinery and improve quality and efficiencies leading to vast amounts of capital expenditure. He said that apart from the development in textile technology, the pace of changes within the industry had also been accelerated by the introduction of man-made fibres and that the recent oil crisis had also had its share of influencing drastically the entire textile industry. Fashion trends, however, had re-established cotton as a truly viable competitive raw material in today's textile market which was not what had been forecast by predictors of a decade ago. Mr. Frame concluded his address by pointing out that research and scientific investigations into all aspects of the textile industry was not new and did not start here in Port Elizabeth. He would, however, like to convey to the Director of the Institute that the centre would render an invaluable service to the local industry if its work were directed at specific South African problems only and that its efforts be also directed at the rediscovery of previous results and the exploitation of these for our cotton industry.

Meetings of Advisory Committees

On April 25th the Director, Dr. D. P. Veldsman, attended a meeting of the Advisory Committee on Wool Production of the Department of Agricultural Technical Services held at the Animal and Dairy Science Research Institute, Irene.

The Advisory Committee on Cotton Production of the Department of Agricultural Technical Services met at the Institute on May 2nd under the chairmanship of Mr. D. de Wet, Assistant-Director, Institute for Crops and Pastures.

The meeting on May 14th of the Advisory Committee on Mohair Production of the Department of Agricultural Technical Services was attended by Mr. Neville Vogt, Regional Liaison Officer for the CSIR.

New Appointments for Director

Dr. D. P. Veldsman, Director of SAWTRI has been appointed Official Observer to the S.A. Cotton Marketing and Promotion Council.

The Minister of National Education, Dr. The Hon. J. P. van der Spuy, has officially appointed the Director to the Council of the College for Advanced Technical Education in Port Elizabeth as representative of the Textile Industry for the period ending March 31st, 1977.



On the occasion of the University of Port Elizabeth's graduation ceremony this year, SAWTRI was well represented with no less than five members of staff receiving academic degrees. From left to right in the photograph appear Mr. A. M. Strydom (M.Sc.); Dr. Derek Turpie (Ph.D.); Professor D. P. Veldsman, Head of the Textile Science Department of the University; Dr. N. Cryer (Doctor Honaris Causa), Textile consultant to the S.A. Bureau of Standards; Dr. L. Hunter (Ph.D.); Mr. H. Silver (M.Sc.); Mr. Mike Cawood (B.Sc.-Textiles)

Director on Overseas visit

Dr. Veldsman departed on an overseas journey on May 19th which took him to Israel where he visited the Israel Fibre Institute and gave a series of lectures on SAWTRI's research work. On the 24th of May, he departed for Aachen, West Germany, where on May 27th, he attended the Planning Committee meeting for the 1975 Quinquennial Wool Research Conference. The Director's overseas visit ended in Ilkley, Yorkshire with a meeting of the Research and Development Committee of the International Wool Secretariat on May 29th and 30th.

Meetings and Addresses

Dr. Veldsman, addressing the Congress of the Mohair Growers' Association in Port Elizabeth on June 11th, informed the delegates about SAWTRI's achievement in removing mechanically, seed from heavily infested mohair. Results have been most encouraging leading to a price increase of seedy mohair.

On June 19th, the Director addressed farmers and other interested persons in Somerset East on the occasion of the annual flock competitions. Dr. Veldsman spoke on research being carried out by SAWTRI on mohair.

SYMPOSIUM ON QUALITY ASSURANCE

A Symposium : Quality Assurance in the Textile Industry, jointly organised by the CSIR and the Textile Institute, will be held in Pretoria on August 7th and 8th in the conference hall of the University of South Africa. With possibly a few minor adjustments, the following papers will be read:—

Principles of Quality Assurance

The Concept of Quality Assurance	E. H. Ingamells
How to Construct Sampling Plans and Control Charts from First Principles	E. Gee
The Control of Yarn and Fabric Quality	Dr. L. Hunter
Quality Control in Dyeing and Finishing	K. Gregory
Basic Laboratory Testing Equipment	J. G. Brink

Quality Assurance in Specific Industries

Quality Control in the Knitting Industry	L. Kerley
Quality Control in the Knitting Industry	Dr. H. Wignall
Quality Control in a Soft Floor Coverings Mill	J. Highley
Quality Control in the Rope Industry	H. V. Liebenberg
Quality Control in a Vertical Worsted Mill	L. Dolpire
Quality Control in a Vertical Cotton Mill	A. Ormerod

Quality Assurance Relating to Specific Products or Processes

Yarn Faults	H. Mueller
Quality Assurance in Cotton Spinning Systems — State of Affairs in 1974	G. Mikula
Grading of Fabrics	Dr. N. Cryer
“The Snap Decision” — The Basis of Meaningful Quality Assessment in Sewing Thread Manufacture and Usage	E. A. Goosen
Quality and the Consumer	Mrs. E. Hivzel

Various Quality Assurance Schemes

Quality Control in a Chain Store	C. N. Peel
Administering of Certification Marks by the South African Bureau of Standards	R. B. Stuart
Wool Mark	J. Brown

SAWTRI PUBLICATONS

Technical Reports:

- No. 219 H. M. Silver – Dyeing of Cotton from a Charged System, Part I: Dyeing with Monochlorotriazine Dyes.
- No. 220 I. W. Kelly – Comparison of Certain Physical Properties of Plain Weave Fabrics from Cotton blended with different Polyester Fibre Types, Part I: Untreated Fabrics.
- No. 221 Buys, Van der Merwe & Van Rooyen – The Dimensional Stability of Single Jersey Fabrics from Wool-rich Blends.
- No. 222 M. H. Strydom – Aspects of the Dyeing of Acrylic Staple Fibre from an Organic Solvent, Part I: Dyeing from a Non-homogeneous System.
- No. 223 Hunter, L. – The Relationship between Certain Yarn and Fibre Properties from Single Wool Worsted Yarns, Part II: Yarn Tensile Properties.
- No. 224 Turpie, D. W. F. – Scouring Conditions, Part III: A Preliminary Study on the Effect of pH and Temperature during Grease Wool Scouring on Neps and Percentage Noil.
- No. 225 Silver, H. M. – Dyeing of Cotton from a Charged System, Part II: Dyeing with Acryloylamide and Trichloropyrimidine Dyes.
- No. 226 Van Rensburg, N. J. J. – Flame Retardant Treatment of Cotton/Polyester Fabrics

ARTICLES APPEARING IN LOCAL AND OVERSEAS JOURNALS

- Veldsman, D. P. Is there a Big Scope for Cotton in South Africa? Supplement to the Natal Witness, May 19th, 1974.
- Veldsman, D. P. Recent Research Findings from South Africa – Part I: Solvent Batch Processing, Shrinkproofing of Wool and Durable Press Fabrics, *Wool Record and Textile World*, Vol. 125, Number 3330 p.29–32 (April, 1974).
- Veldsman, D. P. Recent Research Findings from South Africa – Part II – Mechanical Properties of Yarns and Fabrics, *Wool Record and Textile World*, Vol. 125, No. 3331 p.23 and 27 (April, 1974).
- Veldsman, D. P. Recent Research Findings from South Africa – Part III: Mechanical Processing of Wool in the fields of Conventional and Unconventional Wool Scouring, Carding and Combing, Knitting and Weaving, *Wool Record and Textile World*, Vol. 125, No. 3333, pp. 35, 37 (May 1974).

ABSTRACTS OF RECENTLY PUBLISHED TECHNICAL REPORTS

No. 219 : Dyeing of Cotton from a Charged System, Part I – H. M. Silver

A method for dyeing cotton with monochlorotriazine reactive dyes (i.e. the Cibacrons) using a charged perchloroethylene dyeing system, is described. The aqueous charge consists of 60% H₂O, 7.5% sodium dodecylbenzene sulphonate (SDBS), 5% lauryl monoethanolamide (LEA) and x% dye. The liquor-to-goods ratio is 10:1. The emulsion is prepared by dissolving the dye in the water and emulsifying in the perchloroethylene which contains SDBS and LEA; the temperature is raised to 80°C over 40 min and 5% Na₃PO₄ (dissolved in twice its mass H₂O) is added to fix the dyestuff. Dyeing is continued for another 80 minutes. The fastness to washing and light is similar to that of the same dyes applied from the conventional all-aqueous dyeing system, and dichromatic dyeings from the emulsion system is also feasible. A major advantage of the solvent system is that dyeing may be carried out at 80°C, which is below the azeotropic boiling temperature of a perchloroethylene-water emulsion (87°C). This implies that closed or pressurised dyeing vessels are not a prerequisite when dyeing cotton with Cibacron dyes from an emulsion system.

No. 220 : Comparison of Certain Physical Properties of Plain Weave Fabrics from Cotton blended with different Polyester Fibre Types, Part I – I. W. Kelly

In this study, a comparison was made between blends of cotton and various types of polyester fibre, viz. Trevira 120 (normal), 340 (low pilling) and 140 (high bulk). These fabrics (plain weave, approximately 140 g/m²) were subjected to a few of the more important physical tests, i.e. tensile strength, crease and wrinkle recovery, drape, flexural rigidity, abrasion resistance, pilling propensity and air permeability. It was found that the breaking strength of the yarns and fabrics increased with an increase in the polyester content. The variation in the other properties depended on the type and amount of polyester included in the blend. The wrinkle recovery and appearance after home laundering improved with increasing polyester content, with the low pilling polyester giving the greater improvement. The resistance of the fabrics to abrasion increased with an increase in the polyester content for types 120 and 140, while the opposite was found for the low pilling type.

No. 221 : The Dimensional Stability of Single Jersey Fabrics from Woolrich Blends, – Buys, Van der Merwe & Van Rooyen

“Semi-locknit” single jersey fabrics in wool/polyester (70/30) and wool/cotton (50/50) were produced by feeder blending the yarns on the knitting machine. Different finishing procedures were followed, and the effectiveness of each sequence was assessed for machine washability. Other physical properties, such as bursting strength, Celanese bagging, pilling propensity, air permeability, abrasion resistance and tendency towards edge curling were also determined. It was found

that both types of blend would pass the I.W.S. test for machine washability (specification No. 185) after heatsetting (for the wool/polyester fabric only) or autoclave decatising (for both the wool/polyester and wool/cotton fabric), and subsequently treated with 1.5% Synthappret LKF. A finishing procedure, involving treating the wool yarns prior to knitting with 4.5% Basolan DC and applying 2% aminoplast resin to the fabrics, also proved successful. The latter treatment was also preceded by either heatsetting or autoclave decatising. These finishing sequences eliminated the edge curling problem, but the heat-setting or autoclave decatising operation caused a deterioration of the air permeability, bursting strength and abrasion resistance.

No. 222 : Aspects of the Dyeing of Acrylic Staple Fibre from an Organic Solvent, Part I — M. H. Strydom

A method for dyeing basic dyeable acrylic fibres (Orlon type 42) from an emulsion system is described. Single shades may be obtained by dyeing from a charged perchloroethylene dyebath, the charge consisting of 30–50% H₂O, 5% lauryl monoethanolamide (LEA) and 3% of a quaternary alkyl ammonium salt (e.g. Ciba Retarder A). The bath is set at 60°C, the temperature is raised to 75°C over 10 min and to 100°C over another 40 min. Dyeing for 5 minutes at 98–100°C yields a bath exhaustion in excess of 95%. The normal combination rules for di- and trichromatic dyeings does not seem to hold for the emulsion dyeing system. For self shades the fastness properties and colour value (as measured on the Harrison-Shirley Digital Colorimeter) of the solvent dyed samples do not differ from that of conventional aqueous dyed samples.

No. 223 : The Relationship between Certain Yarn and Fibre Properties from Single Wool Worsted Yarns, Part II — L. Hunter

A wide range of commercially spun yarns (306) and laboratory spun yarns (147, spun at SAWTRI) were analysed in terms of linear density, twist mean fibre length, mean fibre diameter and coefficient of variation (CV) of these properties. The yarn tensile properties (i.e. yarn breaking strength, extension at break and CV of each) were then in turn related to these different parameters. It was found that the mean fibre diameter plays a very important rôle in determining the yarn tensile properties. Statistical analyses, such as regression analyses and determination of correlation coefficients of the two lots individually as well as combined, have led to the following general approximations:

$$\text{Breaking strength} \propto \frac{(\text{Tex})^{1.3} \times (\text{bundle tenacity})^{1.1} \times (\text{m.f.l.})^{0.2} \times (\text{twist})^{0.2}}{(\text{fibre diameter})}$$

$$\text{Extension} \propto \frac{(\text{tex}) \times (\text{bundle extension})^{1.5} \times (\text{m.f.l.})^{0.2} \times (\text{twist})^{0.7}}{(\text{fibre diameter})^{1.4}}$$

Improvement in the tensile properties would only be obtained by careful control of factors influencing the yarn properties, e.g. chemical processing such as dyeing at high temperatures. The results obtained were used to prepare "average" or "expected" values for the yarn tensile properties for undyed, medium shade and dark shade yarns. These tables may be used in practice to rate any single wool worsted yarn in terms of its tensile properties.

No. 224 : Scouring Conditions, Part III – D. W. F. Turpie

A study was made to determine the effect of liquor pH and temperature of scouring on the nep formation and noil produced. The pH was adjusted with soda ash. It was found that the number of neps after conventional carding tended to increase with an increase in liquor pH and temperature. In the absence of soda ash, however, it appeared that less neps were formed with an increase in temperature. As it was established that less soda ash was required to maintain a given pH in the second than in the first bowl, it appeared that less neps were formed with an increase in temperature. As it was established that less soda ash was required to maintain a given pH in the second than in the first bowl, it appeared that fewer neps were formed when the pH of the second bowl was adjusted. Below pH 9,5 the percentage combing noil was independent of pH, but above this value an increase in percentage noil was found with an increase in pH. Again pH adjustment of the second bowl was found to be more beneficial. In the absence of soda ash the temperature of scouring should preferably be 60–65°C, with pH adjustments made to the second bowl if the pH of the aqueous wool extract is too low. The temperature of the first bowl should be below 60°C and the pH less than 9,5 if soda ash is used.

No. 225 : Dyeing of Cotton from a Charged System, Part II – H. M. Silver

Further investigations into the dyeing of cotton from a water-assisted solvent system involved dyeing with the acryloylamide and trichloropyrimidine classes of reactive dyes from a charged perchloroethylene solution. The charge consisted of water, sodium dodecylbenzene sulphonate, lauryl mono-ethanolamide and trisodium phosphate. With the acryloylamide dyes urea was added to the charge. Dyeings were successfully carried out to a depth of shade of 5 *per cent*. After dyeing, the cloths were soaped in an aqueous medium. The fastness properties of the solvent-dyed cloths were as good as those of the aqueous-dyed cloths.

No. 226 : Flame Retardant Treatment of Cotton/Polyester Fabrics – N. J. J. van Rensburg

Observations are reported on some flame retardant treatments of cotton/polyester blended fabrics. All-cotton, polyester, and cotton/polyester blended fabrics containing 80, 60 and 40 *per cent* cotton were treated with tris(2,3-

dibromopropyl) phosphate or titanium tetrachloride/antimony oxide. Some of the fabrics were given a two-step treatment employing both flame retardants. The effect of the treatments on the limiting oxygen index (LOI) values of the fabrics was determined. Fabrics which had received a two-step treatment with tris(2,3-dibromopropyl) phosphate and titanium tetrachloride/antimony oxide were found to have LOI values greater than 0,270 after having been washed for 900 minutes (30 washing cycles) at 60°C. This means that not only are such treated fabrics flame resistant but they can be washed in an ordinary domestic washing machine without adversely affecting the flame retardancy. Such fabrics will probably be acceptable in the United States of America where flame retardancy regulations are stringent.

TEXTILE ABSTRACTS

1. **The Barré Problem:** W. Lewis Willingham, *Textile Industries*, 193 (Sept., 1973).

In order to study the effect of carrier, the author carried out dyeings at 250°F for 1 hour with 4% carrier. It was found that butylbenzoate carriers were the most effective followed by the methyl-naphthalene types and methyl-2-hydroxy-3-methyl benzoate.

As far as optimum carrier concentration and temperature of dyeing are concerned, the author found that, for a minimum barré effect, these two parameters varied from one disperse dye to another. For both low- and high-energy disperse dyes, however, there is an optimum dyeing temperature and carrier concentration.

D.P.V.

2. **Dyeing of Texturised Polyester Yarn:** J. K. Skelly, *Textile Journ. of Australia*, 12 (Febr., 1974).

The author refers to the two texturizing systems, viz. the single-heater false-twist texturizing and double-heater false twist texturizing system. He suggested that for atmospheric dyeing, the fibre/dye affinity relationship for the carrier should favour the fibre whereas under high temperature (HT) conditions the reverse should be the case. Irga-carrier HTP is recommended for HT package dyeing. The functions of the carrier are to promote levelling, improve coverage and minimise recrystallization of the dye or oligomer on cooling the exhausted dye liquor.

D.P.V.

3. **Bringing Easy-care to Cotton.** *Textile Month*, p.63-64 (March 1974).

Mr. Frank H. Burkitt, the Director of Technical Research, International Institute for Cotton, reviewed the progress made in easy-care processing of cotton. Procedures were devised to measure the uniformity of mercerisation and easy-care chemical treatment. It was found that the long established commercial procedures of mercerising and resin finishing gave remarkably uneven results. Liquid ammonia, however, was found to give a very uniform mercerising effect. Furthermore, it was found that the uneven distribution of easy-care chemicals was caused by the migration of the aqueous resin solution to the surface of the fabric during the drying stage immediately after padding. By reducing the water content from the normal 60-70% (based on mass of fabric) to about 30%, migration during drying virtually ceased. This resulted in an improved resistance to abrasion and a significant saving (30-40%) in chemical. Conventional pad mangles are unsuitable for applying the chemicals, but a "minimum application" machine, based on the lick roller principle can be successfully used.

N.J.v.R.

**PROVISIONAL TARIFF SCHEDULE FOR COTTON FIBRE,
YARN AND SPINNING TESTS**

A.	FIBRE AND YARN TESTS	Price per sample	
		Ten samples	Eleven samples and more
1.	Bundle breaking strength (Stelometer) 0-gauge or $\frac{1}{8}$ -gauge	R3,50 per gauge	R3,00 per gauge
2.	Fibre length (Fibrograph Model 330) 2,5% Span length) 50% Span length) Uniformity ratio)	R1,00	R1,00
3.	Micronaire value (Port-Ar)	R1,00	R0,75
4.	Immaturity ratio and fibre fineness ($\mu\text{g}/\text{inch}$) (Arealometer method)	R2,50	R2,00
5.	Ginning (Laboratory Roller Gin) (In cases where seed cotton samples are supplied)	R2,00	R1,50
6.	Yarn breaking strength (Single strand – Uster)	R6,00 (First sample)	R4,00 (Subsequent samples)
7.	Yarn skein breaking strength	R2,50 (First sample)	R2,00 (Subsequent samples)
8.	Yarn uniformity (CV%, Neps, Thick and Thin places)	R8,00 (First sample)	R4,00 (Subsequent samples)

B.	SPINNING TESTS	Price per sample (minimum 10 samples)
1.	<p>Small scale spinning test (Shirley miniature spinning plant)</p> <ul style="list-style-type: none"> ● One yarn count (15 or 30 tex, 380 Twist Constant) (or as specified by client) ● Yarn strength (Skein breaking strength – CSP) ● Yarn uniformity (if enough material is available) ● Yarn appearance (ASTM) ● Fibre analysis (A1 to A4) if required; R6,00 extra (A <i>minimum</i> of 200 grams of <i>lint</i> required. If trash content is also required, then 300 grams (<i>minimum</i>) <i>lint</i> must be supplied) 	R30,00 (per sample)
2.	<p>Large scale spinning test (Commercial machines)</p> <ul style="list-style-type: none"> ● Two yarn counts (15 and 30 tex) ● Yarn strength (Skein and single strand) ● Yarn uniformity (CV%, Neps, Thick and Thin places) ● Yarn appearance ● Neps in card web ● Fibre analysis (A1 to A4) <p>A maximum of 40 kg of lint will be processed. (Cost of cotton and transport to SAWTRI will be borne by the client. The spun yarn and waste fibre become SAWTRI's property unless otherwise arranged).</p>	R300 (per sample)
3.	<p>Extra large scale spinning and fabric test</p> <p>A minimum of 50 kg (but not more than 150 kg) of lint will be spun into yarn and then converted into woven and/or knitted fabric. Apart from the standard fibre and yarn tests (A1 to A4, and A6, A7 and A8) the woven and/or knitted fabric will be subjected to a wide range of performance tests such as:</p> <p style="padding-left: 40px;">breaking strength and elongation, abrasion resistance, wrinkle resistance, dyeing and finishing performance, drape, etc.</p>	

Contd:

B.	SPINNING TESTS	Price per sample (minimum 10 samples)
	<p>The type of fabric(s) to be produced and the tests to which it will be subjected as well as the particular finishing and dyeing treatments will be decided upon individually for each cotton in collaboration with the client.</p> <p>It is estimated that a comprehensive test of this nature will cost between R2 000 and R3 000 and individual quotations will be given for each lot of cotton to be tested. A comprehensive report will be prepared, covering the performance of the cotton from fibre to fabric in each case.</p> <p>(Cost of cotton and transport to SAWTRI will be borne by the client. The spun yarn, fabric and waste fibre become SAWTRI's property unless otherwise arranged).</p>	

AN IMPROVED PROCESS FOR THE CHLORINATION OF WOOL WITH DCCA

by E. C. HANEKOM and F. A. BARKHUYSEN

ABSTRACT

A general description is given of an improved continuous chlorination process for wool in the form of tops or fabrics. The process consists basically of padding the wool with a solution consisting of an alkali salt of dichloroisocyanuric acid and an acid mixture of an inorganic and organic acid at pH levels between 1 and 2. Very effective and uniform chlorination was achieved with this process.

KEY WORDS

Wool – Shrink-resist – chlorination – dichloroisocyanuric acid – acetic acid.

INTRODUCTION

Numerous methods to prevent the felting of wool fabrics have been developed in past years with varying degrees of success. One of the oldest methods is the chlorination (oxidation) of wool. It has long been known that the chlorination reaction should be as uniform as possible from fibre to fibre to ensure the best shrink-resist results⁽¹⁻³⁾.

Many shrink-resist methods require the chlorination of wool as a pretreatment before the application of a resin to the wool fibres. Uniform chlorination of the wool results in the uniform spreading of the resin on the wool fibres, a factor which is of the utmost importance to obtain the best shrink-resist results.

The main purpose of this report is to give a brief description of a highly successful new chlorination process. Patent rights for this process have been applied for by the South African Wool Board who co-sponsored this work.

EXPERIMENTAL

Materials:

Merino wool top (64's quality) having a mean fibre length of 75,1 mm and dichloromethane extractable matter of 0,37% was used. A nonionic surfactant, Tergitol Speedwet (Union Carbide) was used as wetting agent. Potassium dichloroisocyanurate, (Basolan DC-B.A.S.F.) was used as the chlorinating agent. Laboratory grade acids were used.

Chlorination of Wool Top:

The chlorination process consists basically of using a DCCA salt, such as Basolan DC, as the chlorine donor and an acid mixture consisting of an inorganic acid and an organic acid which is not readily oxidised or halogenated. Suitable organic acids, for example, are acetic acid, propionic acid and halogenated derivatives of acetic acid. The components (with a suitable wetting agent) are then mixed to form the chlorination solution at the desired active chlorine concentration and pH level, preferably below pH 2.

Wool is then chlorinated by padding it with the solution on a horizontal pad mangle, storing it for 1–3 minutes and then neutralising and dechlorinating it in the normal manner. The contact time of the wool with the solution in the nip is of the order of 1 second. When strong organic acids such as trichloroacetic acid are used chlorination solutions with a pH of 2 can easily be obtained without having to add an inorganic acid to the solution. Two examples of the chlorination process are given below:

Example 1:

Basolan DC (25 g) was dissolved in 860,7 g water and wetting agent (5 g Tergitol Speedwet) was added to the solution. The solution was then acidified to pH 1,9 with a mixture consisting of 100 g glacial acetic acid and 9,3 g 18 N sulphuric acid. Wool top was padded with this solution (100% pick-up), stored for 3 minutes and then neutralised and dechlorinated with a solution containing 3% sodium bicarbonate and 3% sodium bisulphite, rinsed and dried.

Example 2:

Basolan DC (25 g) was dissolved in 950,5 g water and wetting agent (5 g Tergitol Speedwet) was added to the solution. The solution was acidified to pH 2 by the addition of 19,5 g trichloroacetic acid to the solution. Wool top was then treated with this solution as described in example 1.

RESULTS AND DISCUSSION

Veldsman and Swanepoel⁽⁴⁾ investigated the influence of the rate of chlorination on the shrink-resist treatment of wool with DCCA by varying the pH, temperature and reagent concentration of the chlorination solutions. They found that the pH of the solution was by far the most important factor which influenced the rate of chlorination. Until now solutions containing relatively high concentrations of DCCA could not be used at pH values below 2 because of the rapid precipitation of the DCCA under these conditions. By using suitable organic acids, however, sufficiently stable solutions can be prepared at pH values below 2 containing relatively high concentrations of DCCA.

Excellent shrink-resist results have recently been obtained for resin treated wool tops pretreated with the new chlorination process^(5, 6). These results, some of which will be published shortly, confirm the importance of the pH factor.

The critical surface tension of wool fibres from a top which was treated with the new process was determined and the results clearly showed the effectiveness and uniformity of the treatment⁽⁶⁾.

CONCLUSIONS

Highly uniform and effective chlorination of wool can be obtained by using the improved chlorination process. This process is therefore particularly suitable as a pretreatment for wool which is to be rendered shrink-resistant by the subsequent application of a suitable resin.

ACKNOWLEDGEMENTS

The authors wish to thank the S.A. Wool Board for permission to publish this report.

PROPRIETARY NAMES

The fact that chemicals with proprietary names have been mentioned in this report does not in any way imply that SAWTRI recommends them or that there are no substitutes which may be of equal value or even better.

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PRELIMINARY REPORT ON A DCCA/POLYAMIDE-EPICHLOROHYDRIN RESIN PROCESS FOR RENDERING WOOL TOPS SHRINKRESISTANT

by E. WEIDEMAN and HILKE GRABHERR

ABSTRACT

A polyamide-epichlorohydrin resin can be used to render wool shrinkresistant employing the potassium salt of dichloroisocyanuric acid (DCCA) at a low pH (1,5–2,0) as a pretreatment. Suction drum backwash bowls were not required for this shrinkproofing process since it was found that the wool was evenly treated using a pad mangle and four bowls. The effect of dechlorination media, chlorine concentration, various rinsing solutions and storage time on the area shrinkage of samples knitted from the treated tops was investigated.

The resin can also be applied in a batch process after the DCCA treated tops have been processed into yarn and knitted fabrics, thereby rendering them shrinkresistant.

KEY WORDS

Wool – shrinkresistant – chlorination – DCCA – polyamide-epichlorohydrin resin.

INTRODUCTION

The chlorine/Hercosett* process comprises chlorination pretreatment followed by resin for wool tops which provides machine washable end commodities^(1, 2). The chemistry of the process has been discussed^(3–5) and possible explanations about the mechanism of shrinkproofing have been given⁽⁶⁾.

The pretreatment before resin application involves an oxidation of the wool by employing an acid chlorination (usually at a pH of 1,8 to 2,0). One of the major problems so far has been even treatment so that the resin could spread evenly over the surface of the wool fibres⁽⁷⁾. To achieve level oxidation commercially, it was found that *suction drum* backwash bowls had to be used. This involves considerable capital investment and it will be shown in this report that by utilising a new uniform pretreatment⁽⁸⁾, and a polyamide-epichlorohydrin resin, a pad mangle and four bowls (without suction drums) can be used to render wool machine washable.

*Hercosett (Hercules Inc), a polyamide-epichlorohydrin resin

EXPERIMENTAL

Merino wool top (64's quality) with a mean fibre length of 58,5 mm which had been scoured to a grease content of 0,37% were used. Technical grade chemicals were used throughout except sulphuric acid and glacial acetic acid which were of reagent grade. Basolan DC (B.A.S.F.) containing 60% active chlorine was used to represent DCCA and Hercosett 70 to represent the polyamide-epichlorohydrin resin. All percentages are given as mass per volume except in the case of chlorine where the percentage chlorine (percentage *active* chlorine) is given as mass on mass of wool and all solutions were used at room temperature (20–23°C), except where otherwise indicated.

The wool tops were treated in a Benz laboratory continuous padding and steaming apparatus comprising a pad mangle and four bowls. A Fleissner oven was used for drying at 60°C and curing the resin at 90°C. The tops were passed through at a speed of 3 metres/minute and the wool was immersed in the solution in the padder for about 1 second and in the bowls for 12 seconds. The chlorination was performed in the pad mangle using a solution which contained 10% (v/v) glacial acetic acid and 0,5% Tergitol Speedwet (Union Carbide). The pH of the solution was lowered to 2,0 or 1,5 using 50% (v/v) sulphuric acid and the DCCA concentration varied from 2,34% to 3,34% for the different experiments. The tops were squeezed to a wet pick up of 100%.

The wool top was stored for 4 minutes after chlorination so that the DCCA could react with the wool, except where the effect of various storage times was investigated. This store procedure was followed in other work employing DCCA in a continuous process (the Pad/Store method⁽⁹⁾). The top was subsequently *dechlorinated* in the first bowl using a mixture of 1% sodium bisulphite and 2,5% sodium bicarbonate except where the influence of dechlorination media was studied. In the latter case one of the following solutions was used:—

- 3% sodium bisulphite, or
- 1% sodium bisulphite + 2,5% sodium bicarbonate, or
- 1% sodium bisulphite + 2,5% sodium carbonate.

The *second* bowl contained 1% sodium bicarbonate representing the *rinsing* bowl. Where various rinsing media were studied one of the following solutions was used:—

- 3% sodium bicarbonate (room temp.), or
- 3% sodium bicarbonate (45°C), or
- 1% sodium carbonate (room temp.)

The *third* bowl contained a mixture of 2% Hercosett 70 and 2% sodium bicarbonate. The *fourth* bowl contained a mixture of a softener 1% Mystolube S (Catomance) and 0,5% sodium bicarbonate.

After curing, the tops were gilled and 2,8 ktex rovings prepared. Subsequently yarns of R354 Tex S82/2Z108 were spun on an I.W.S. Sample Spinner Twister*.

*The I.W.S. Sample Spinner Twister was built for use as part of the plant quality control for companies operating the I.W.S. Superwash process.

A 30 cm x 30 cm square was knitted (single jersey) to a cover factor of 12,9 (worsted 1,1). The knitted cloth was drycleaned in perchloroethylene and washed in a Cubex machine according to the I.W.S. Test method No. 132 and the percentage area shrinkage determined after washing for three hours.

A preliminary experiment applying the Hercosett 70 resin in a batch application was also carried out on wool tops which had been chlorinated (1,5% chlorine, pH 1,5) and dechlorinated by the continuous method (described above). After chlorination yarns were spun and knitted into fabrics as described above. The knitted fabrics were treated at a wool to liquor ratio of 1 : 35. The goods were wetted out with 0,5 g/l Tergitol Speedwet, 2,2% (o.m.f.) Hercosett was added and the reagent bath was agitated for 20 min at 35°C. The pH of the bath was gradually increased over 10 min to 7,0 by the addition of a concentrated solution of sodium bicarbonate. The pH was then further increased over 10 min to 8,0 by the addition of sodium carbonate. The temperature was subsequently increased to 45°C and maintained for 15 min. The sample was rinsed at room temperature, immersed in a 0,5% Mystolube solution for 15 minutes, spindried, dried, cured and washed as mentioned earlier.

The Hercosett content of the wool was determined according to the method of Swanepoel *et al*⁽¹⁰⁾. The critical surface tension (c.s.t.) of the wool fibres was determined according to the float-sink method⁽¹¹⁾.

RESULTS AND DISCUSSION

It is apparent from Table I that a shrinkresistant wool was obtained for chlorine concentrations varying from 1,4 to 2,0 *per cent* (o.m.f.) and at pH 1,5 and 2,0. It is possible that an even lower concentration of chlorine could be used since

TABLE I

THE EFFECT OF CHLORINE CONCENTRATION ON THE AREA SHRINKAGE OF KNITTED FABRIC

% ACTIVE CHLORINE	% AREA SHRINKAGE*	
	pH 1,5**	pH 2,0**
1,4	0,8	—
1,6	-3,9	-1,0
1,8	—	-5,3
2,0	—	-3,4

Dechlorination was effected using 1% NaHSO₃ + 2,5% NaHCO₃

*After the tops were chlorinated 2% Hercosett 70 was applied

**pH at which wool was chlorinated

it was found in some other experiments (using the same chlorination procedure) that the c.s.t. of wool chlorinated with 0,8, 1,0 and 1,2% chlorine was >66, >70 and >73 respectively. These values are high enough to facilitate resin spreading. It was previously found, however, that in the case of tops, although the c.s.t. exceeded the minimum required, a satisfactory level of shrinkresistance could not be achieved^(1,2).

The effect of the various *rinsing solutions* on the area shrinkage of the wool is shown in Table II. For both levels of chlorination there seem to be only marginal differences between the various rinsing solutions. The rinse in 1% sodium bicarbonate solution at room temperature seems to be slightly better than the others. The percentage Hercosett on the wool varied from 1,8 to 2,3%.

The effect of various *dechlorination media* on the area shrinkage is shown in Table III. The results indicate that dechlorination with sodium bisulphite only, or sodium bisulphite plus sodium carbonate, resulted in a greater area shrinkage than a dechlorination with sodium bisulphite plus sodium bicarbonate. This is in agreement with earlier work^(1,2).

The effect of *storage time* after chlorination on the area shrinkage of wool chlorinated with 2% chlorine (o.m.f.) at pH 2 was also investigated (Table IV). It would appear that a relatively short storage time (50 seconds) could be used. This may not necessarily be the case at lower chlorine concentrations and this aspect will have to be investigated in more detail.

Finally, it was found that Hercosett 70 could be exhausted in a batch process on knitted fabric which had been chlorinated previously in top form according to the continuous method described above. The area shrinkage of fabrics treated in the above manner was found to be less than 5% after a 3 hour wash.

TABLE II
THE EFFECT OF VARIOUS RINSING MEDIA ON THE AREA SHRINKAGE OF KNITTED FABRIC

RINSE AFTER DECHLORINATION	% AREA SHRINKAGE*	
	1,4% Cl ₂ **	1,6% Cl ₂ **
1% NaHCO ₃	0,8	-3,9
3% NaHCO ₃	1,4	1,3
3% NaHCO ₃ - 45°C	3,7	5,9
1% Na ₂ CO ₃	2,2	2,9

Dechlorination was affected using 1% NaHSO₃ + 2,5% NaHCO₃.

* Wool chlorinated at pH 1,5 and 2% Hercosett 70 applied..

**on mass of wool

TABLE III**THE EFFECT OF VARIOUS DECHLORINATION MEDIA ON THE AREA SHRINKAGE OF KNITTED FABRIC**

DECHLORINATION MEDIUM	% SHRINKAGE*	
	1,4% Cl ₂ **	1,6% Cl ₂ **
3% NaHSO ₃	4,0	3,4
1% NaHSO ₃ + 2,5% NaHCO ₃	0,8	-3,9
1% NaHSO ₃ + 2,5% Na ₂ CO ₃	8,0	1,5

*Wool chlorinated at pH 1,5 and 2% Hercosett 70 applied

**on mass of wool

TABLE IV**THE EFFECT OF STORAGE TIME ON THE AREA SHRINKAGE OF KNITTED FABRIC**

STORAGE TIME (seconds)	% AREA SHRINKAGE
50	-3,0
120	-0,2
240	-3,4

Wool chlorinated at pH 2,0

CONCLUSIONS

Preliminary results showed that wool tops chlorinated according to recent work can be rendered shrinkresistant to comply with machine washable specification by using a polyamide-epichlorohydrin resin. A pad mangle and four bowls were used.

Resin can be applied by either a continuous or a batch process.

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THE USE OF PROPRIETARY NAMES

The fact that chemicals 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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THE USE OF DCCA AND POLYAMIDE-EPICHLOROHYDRIN/ POLYACRYLATE RESINS FOR RENDERING WOVEN WOOL FABRICS SHRINKRESISTANT

by E. WEIDEMAN and HILKE GRABHERR

ABSTRACT

It was found that a woven wool fabric could be rendered shrinkresistant in a continuous process with 2% DCCA (1,2% active chlorine) and 0,3% polyamide-epichlorohydrin resin (PAE resin). The chlorination was carried out at a pH of 1,5 or 2,0. When a mixed resin (PAE/polyacrylate) was used, 1% DCCA (0,6% active chlorine) was sufficient as a pretreatment to produce a shrinkresistant fabric.

KEY WORDS

Wool — dichloroisocyanuric acid — polyamide-epichlorohydrin resin — polyacrylate resin — shrinkresistant — woven fabrics.

INTRODUCTION

Wool fabrics have been rendered shrinkresistant with the salts of dichloroisocyanuric acid (DCCA) and generally very high levels (2–5%) of DCCA are required to produce shrinkresistant wool^(1, 2). Wool fabrics treated with DCCA at pH 5–6 will, however, not pass the current severe washing tests. It is also known that a considerable mass loss occurs when DCCA treated wool is dyed. The current trend is therefore to apply a resin to the wool after the DCCA treatment. Hanekom *et al*⁽³⁾, for instance used acid colloid methylolmelamine/polyethylene resins to produce shrinkresistant wool fabrics. The fabrics were pretreated with DCCA (1% active chlorine) at pH 4,5–5,0, followed by 0,75 *per cent* resin. Such wool fabrics were subjected to the fairly severe washing test of the Australian Wool Board and were found to be shrinkresistant. The chlorination of wool with DCCA at low pH values was introduced recently⁽⁴⁾ and this pretreatment is evaluated in this paper for use with a PAE resin and also for use with a mixture of a polyacrylate resin and a PAE resin.

EXPERIMENTAL

All percentages are given as mass per volume except where indicated otherwise. In the case of chlorine the percentage chlorine (percentage *active* chlorine) is given as mass on mass of wool. All solutions were used at room temperature (23–25°C) except where indicated otherwise.

Fabrics:

Two unfinished woven worsted wool fabrics were used. The first, which had a mass per unit area of 147 g/m^2 will be referred to as standard I.W.S. fabric, and the second, which had a mass per unit area of 130 g/m^2 will be referred to as the SAWTRI fabric. The fabrics were dry cleaned in perchloroethylene prior to chlorination.

Chemicals:

Technical grade chemicals were used, except sulphuric acid and glacial acetic acid which were of reagent grade quality. Basolan DC (B.A.S.F.) containing 60% active chlorine was used to represent DCCA and Hercosett 70 (Hercules Inc.) (25% solids) to represent the PAE resin. Three different polyacrylates were used: Revertex A275 (Revertex S.A.), Primal E485 and Primal E358 (Rohm and Haas). All the polyacrylates contained 45% solids. Lissapol NX (I.C.I.) was used as an emulsifying agent.

Apparatus:

A modified Benz laboratory continuous padding and drying apparatus comprising a pad mangle, four bowls and an oven was used for continuous treatments. A Gevel winch was used for the batch treatments.

Preparation of mixed resins:

Two resin mixtures were prepared. One mixture contained 2,25% polyacrylate and 0,4% Hercosett 70 and the other 1,75% polyacrylate and 0,3% Hercosett 70. The resin solutions were prepared in a specific manner and the 2,25% polyacrylate/0,4% Hercosett mixture is given as an example:

Polyacrylate (5 g) was added to Lissapol (1 g) dissolved in water (10 g) and thoroughly stirred. Hercosett 70 (1,6 g) was likewise added to Lissapol NX (0,32 g) dissolved in water (5 g). The solution containing the Hercosett resin was subsequently added slowly to the polyacrylate mixture whilst stirring. Finally water (77,08 g) was slowly added to this resin mixture whilst stirring.

Shrinkresist treatments:

Two chlorination processes were used as a pretreatment prior to resin application namely a continuous chlorination process and a batch chlorination process. After the continuous chlorination the resin was either padded on or exhausted in a batch process. After the batch chlorination process the resin was applied by an exhaustion process only.

Continuous chlorination:

The fabrics were padded in a pad mangle to a wet pick-up of 95–105% in a solution containing 10% (v/v) glacial acetic acid and 0,5% Tergitol Speedwet (Union Carbide) and the required amount of Basolan DC to give chlorination levels of 0,6 to 1,5%. Sulphuric acid was used to adjust the pH to 1,5 or 2,0. After chlorination

the samples were stored for four minutes and subsequently dechlorinated in the first bowl containing 3% sodium metabisulphite and 3% sodium bicarbonate. The next two bowls contained tap water. Fabrics were passed through the apparatus at speeds of either 2 or 3 m/min and this resulted in contact times in the chlorinating solution of 1,5 and 1 second respectively and 18 and 12 seconds respectively in the dechlorinating and rinsing bowls.

Resin treatment of the fabrics:

The fabrics were air dried prior to resin application. Fabric samples were padded continuously to a wet pick-up of 95–105% with a solution of Hercosett 70 resin or mixed resins. Samples were air dried and subsequently cured at 90°C for 15 minutes. The drying and curing of the fabrics could not be carried out continuously due to the fact that only laboratory drying and curing apparatus was available. However, it is known that Hercosett resin and certain polyacrylates can be efficiently cured in a continuous process using normal backwash driers⁽⁵⁾.

The Hercosett resin or mixed resin was also exhausted from a solution in a batch process. The fabric was wetted out in a 0,05% Tergitol Speedwet solution. Hercosett 70 or mixed resin was added and the temperature increased to 35°C over a period of 15 minutes and maintained for a further 15 minutes. The pH of the solution was increased to 7 with sodium bicarbonate and after 5 minutes the bath was dropped. The fabric was hydroextracted, dried and cured as described earlier.

Batch chlorination and resin exhaustion:

A liquor to goods ratio of 40:1 was used. Chlorination was carried out at pH 4,5 in a sodium acetate-acetic acid buffer solution containing 0,05% Tergitol Speedwet. Samples were chlorinated with Basolan DC to a level of 1,3% chlorine and dechlorinated for 10 minutes by adding 2% (o.m.f.) sodium metabisulphite to the bath. The pH of the solution was increased to 7,0 using sodium bicarbonate. Hercosett resin or a polyacrylate/Hercosett resin was added and the same procedure was followed as described earlier.

Test Methods:

The fabric samples were washed in a 50 l Cubex (I.W.S.) machine according to the I.W.S. test method No. 132 and the percentage total area shrinkage (relaxation and felting) determined after washing for three hours. The Hercosett content of the wool was determined according to the method of Swanepoel *et al*⁽⁶⁾.

RESULTS AND DISCUSSION

A SAWTRI woven wool fabric, *continuously* pretreated with DCCA (1,3% active chlorine) in the pad mangle at pH 1,6, was treated with various resins (see Table I). The resins were either *padded* on to the wool or *exhausted* in a batch

process. The total area shrinkage was less than 5% after a three hour wash in a 50l. Cubex apparatus. From Table I it is apparent that a shrinkresistant fabric was obtained by using a mixed resin (polyacrylate and Hercosett 70). Little difference was found between the three different polyacrylates tested. The chlorinated wool was also found to be shrinkresistant where only 0,4% Hercosett 70 and no polyacrylate was applied. When the chlorination was performed at pH 4,5 in a *batch exhaustion* process the fabric was not shrinkresistant after resin application.

The continuous DCCA pretreatment at a low pH raises the critical surface tension to a higher value than when the chlorination is performed at a higher pH level resulting in the resin spreading better in the former case^(5, 7). It was shown that the rate of chlorination was dependent on the pH of the DCCA solution, increasing with decreasing pH values^(8, 9). Apparently the rate of chlorination is too slow at higher pH values and the chlorination process is therefore not only restricted to the surface of the fibres, but some chlorine probably diffuses into the fibres. In the case of other pretreatments e.g. with hypochlorite, it is generally known that the best chlorination is achieved at low pH values (1,5–2,0).

TABLE I

THE EFFECT OF VARIOUS RESIN TREATMENTS ON THE AREA SHRINKAGE OF SAWTRI WOOL FABRICS*

TREATMENT	% AREA SHRINKAGE		
	Continuous Chlorination at pH 1,6		Exhaustion Chlorination at pH 4,5
	Resin Padded	Resin Exhausted	
2,25% Revertex A275/ 0,4% Hercosett 70	1,0	1,2	—
2,25% Primal E485/ 0,4% Hercosett 70	1,1	3,6	—
2,25% Primal E358/ 0,4% Hercosett 70	0,3	2,8	35
0,4% Hercosett 70	2,8	2,1	24
Untreated fabric	77		

*Fabrics padded at 2 m/min; 1,3% active chlorine

The rate of chlorination is dependent on the concentration of the chlorinating reagent and it is therefore concluded that the concentration of the chlorine in the case of the batch exhaustion process was probably too low and the pH probably too high to obtain an effective modification of the fibre surface. It seems that DCCA will therefore be most effective for the modification of the fibre surface when used at a low pH value and sufficient high concentration.

The effect of the chlorine concentration, during a continuous chlorination process, on the area shrinkage of resin-treated I.W.S. material was also investigated. The results appear in Table II. A shrinkresistant fabric was obtained with 1,2% or more chlorine, followed by 0,3% or 0,4% Hercosett 70. Using a mixed resin 0,6% chlorine was sufficient to produce a shrinkresistant fabric. The Revertex A275 seemed to produce slightly better results than the Primal E485. There was no difference in the percentage shrinkage whether 2,25% polyacrylate/0,4% Hercosett 70 or 1,75% polyacrylate/0,3% Hercosett 70 was used as shrinkproofing resins.

TABLE II
THE EFFECT OF VARIOUS RESIN TREATMENTS AND PERCENTAGE CHLORINE ON THE AREA SHRINKAGE OF I.W.S. STANDARD WOOL FABRIC*

RESIN TREATMENT	% AREA SHRINKAGE FOR A PRETREATMENT OF			
	0,6% Cl ₂	0,9% Cl ₂	1,2% Cl ₂	1,5% Cl ₂
Chlorinated only	76,4	75,3	61,7	59,2
0,3% Hercosett 70	59,7	23,6	6,6	5,2
0,4% Hercosett 70	51,9	16,0	5,2	5,2
2,25% Revertex A275/ 0,4% Hercosett 70	3,0	2,5	2,5	3,6
1,75% Revertex A275/ 0,3% Hercosett 70	3,8	3,5	3,1	2,6
2,25% Primal E485/ 0,4% Hercosett 70	5,7	4,3	7,1	6,3
1,75% Primal E485/ 0,3% Hercosett 70	5,5	5,9	6,6	5,9

*Fabrics padded at 3 m/min; Chlorinated at pH 2,0

TABLE III

THE EFFECT OF pH OF CHLORINATION ON THE SHRINKAGE OF RESIN TREATED I.W.S. STANDARD WOOL FABRIC*

TREATMENT	0,6% Cl ₂		1,2% Cl ₂	
	pH 1,5	pH 2,0	pH 1,5	pH 2,0
Chlorinated only	75,9	76,4	—	61,7
2,25% Revertex A275/ 0,4% Hercosett 70	1,6	3,0	3,5	2,5
2,25% Primal E485/ 0,4% Hercosett 70	4,0	5,7	7,1	5,9
1,75% Revertex A275/ 0,3% Hercosett 70	2,1	3,8	3,5	3,1

*Fabrics padded at 3 m/min.

TABLE IV

THE PERCENTAGE HERCOSETT ON THE WOOL FABRICS

RESIN TREATMENT	PERCENTAGE HERCOSETT
2,25% Revertex A275/ 0,4% Hercosett 70	0,3
0,4% Hercosett 70	0,3
1,75% Primal E485/ 0,3% Hercosett 70	0,2

Table III shows a comparison between the results obtained when continuous chlorination was carried out at two different pH values. It can be seen that there was little difference between the total area shrinkage of wool fabrics chlorinated at pH 1,5 or 2,0. Once again the Revertex A275 produced slightly better results than the Primal E485. A lower resin add-on e.g. 1,75% Revertex A275 and 0,3% Hercosett 70 also produced shrinkresistant fabrics.

The percentage Hercosett on the wool was determined to see if the Hercosett had not been exhausted onto the wool from the padder thereby resulting in higher levels of add-on than anticipated. Table IV shows that the values found, agreed with the concentrations that had been padded onto the wool.

CONCLUSIONS

Chlorination of wool with DCCA at low pH values can be used as a pretreatment before resin application to produce shrinkresistant fabrics. It would appear that the chlorination is successful when applied continuously in a pad mangle at pH 2 but not in a batch exhaustion process at pH 4,5. The resin may subsequently be applied continuously or in an exhaustion process. Surprisingly low concentrations of Hercosett 70 (0,3–0,4%) can be used to obtain shrinkresistant fabrics. It was found that then at least 2% DCCA (1,2% active chlorine) must be used as a pretreatment. When mixed resins consisting of Hercosett and a polyacrylate are used, chlorine levels of approximately 0,6% are sufficient to obtain shrinkresistant fabrics.

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THE USE OF PROPRIETARY NAMES

The fact that chemicals 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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THE EVAPORATION OF WOOL SCOURING EFFLUENTS ON AN EXPERIMENTAL SCALE

by D. W. F. TURPIE

ABSTRACT

Evaporation experiments carried out on different, specially prepared wool scouring effluents showed that the efficiency of evaporation tended to be approximately proportional to the percentage of the surface area of effluent not covered by grease. The percentage of the surface area covered with grease, however, was not necessarily proportional to the amount of grease in the effluent but could depend, for example, on emulsion stability.

KEY WORDS

Evaporation — Class A evaporation pan — wool scouring effluent — grease content.

INTRODUCTION

Protection of all existing and potential water resources is necessary because of the growing demand for water for industrial, agricultural and domestic purposes. Prevention of pollution is an important aspect of such protection⁽¹⁾.

One of the criteria which may be used for assessing the purity of a stream is the "biological oxygen demand" or BOD⁽²⁾. It has been estimated that a scouring set having a daily input of 15 metric tons of raw wool would produce an amount of effluent which would need a daily biological oxygen consumption, equivalent to the oxygen needs of a population of over 45 000⁽³⁾. The effluent from wool scouring liquors can therefore be a source of severe pollution if discharged directly into a stream. Many other textile effluents can also be sources of pollution.

Effluents may be treated in various ways (with varying degrees of efficiency) to reduce their polluting potential and then disposed of with relative safety, or may even be re-used^(4, 5). On the other hand some effluents are discharged into evaporating ponds or dams. In order that the latter may comply with the requirements to prevent pollution it is important for the ponds to be lined so that the underground water is not contaminated. Since no seepage can then occur the water level in the pond is primarily a function of evaporation, rainfall and the input rate of effluent. When such a pond is used for the effluent from wool scouring liquors, however, the rate of evaporation is likely to be significantly affected by the composition of the effluent since a grease-rich scum would tend to reduce the surface area available for evaporation. This would mean that the area of the pond required for a given input rate of effluent may well depend upon the grease content of the effluent. Accordingly it seemed of interest to ascertain the relative evaporation rates of wool scouring liquors of different composition using standard evaporation pans.

A network of evaporation pans in several localities throughout Southern Africa is used for determining the respective rates of evaporation of water. Two types of standard evaporation pans are used – the Symons pan, which is 1,8 x 1,8 m square (6' x 6') in plan and 61 cm (2') in depth and which is sunken to a depth of 53 cm (1' 9''), and the American Class A pan, which is circular in plan, of diameter 1,2 m (4') and depth 25 cm (10'') and which is raised 15 cm (6'') above original ground level. Studies carried out by the South African Department of Water Affairs have established that a multiplication factor of 0,85 applied to the monthly evaporation from a Symons pan gives the approximate corresponding value for the evaporation from an adjacent storage reservoir, although this does tend to vary with the season of the year and with other factors^(6, 7). It has also been established that the ratio of gross evaporation loss from a Class A pan to that from a Symons pan (taken over 38 evaporation stations) is approximately 1,30 over a twelve month period, although this ratio also tends to vary with the season of the year⁽⁸⁾.

By using either type of the above standard evaporation pans results obtained in Port Elizabeth, on scouring effluent and on water, could be extrapolated to provide, for example, an anticipated evaporation rate for a liquor of similar composition in a lined pond elsewhere.

EXPERIMENTAL

A standard rain gauge was set up about 80 metres from the nearest building and 15 metres from the nearest scrub on a level, grassed field at this Institute. Three unpainted Class A evaporation pans were arranged symmetrically around the rain gauge, their centres being 2,4 metres from the gauge in each case.

Initially, all the pans were filled with tap water to the same level. Thereafter (excepting at weekends) the levels in the pans were read daily at 08h15 with rainfall measurements recorded simultaneously. The average daily gross evaporation was then compared with that recorded at the nearby Port Elizabeth Airport. The above experiment was commenced on October 3rd and completed on November 6th 1973, after which the tanks were emptied.

On November 7th 1973 the tanks were filled with specially prepared effluent each differing substantially in grease content. These liquors were all prepared from the same bulk sample of industrially produced scouring effluent which contained, on analysis, 1,0% by mass of wool grease. The liquors were prepared in the following manner: One-third of the bulk sample was transferred to a suitable tank and its grease content increased to *three per cent* by adding *two per cent* of wool grease. A circulating pump was then brought into operation for a short time to mix in and emulsify the added grease. Another third of the bulk sample was treated in a similar manner excepting that its grease content was increased to *one and one half per cent* by adding *half a per cent* of wool grease. The wool grease used in this and in the previous case was a commercial grade of centrifuged wool grease obtained from a local supplier. The remaining third of the bulk sample was "degreased" in a

Westphalia disc type centrifugal separator after approximately two *per cent* of benzine* had been emulsified in the liquor. The benzine was injected by a diaphragm-type metering pump into the inlet side of the centrifugal pump serving the Westphalia. On analysis the "degreased" liquor was found to contain 0,3 *per cent* of dichloromethane extractable matter.

The three liquors as prepared above thus contained approximately 3,0 1,5 and 0,3 *per cent* of wool grease but were otherwise of similar composition. These liquors were each treated with one *per cent* by volume of commercial grade formaldehyde solution (45%) to prevent degradation and putrefaction, part used immediately to fill the evaporation pans to the required level and the remainder stored in sealed 200 l drums for the purpose of topping up the pans when necessary.

The levels in the pans were read daily (excepting at weekends), with rainfall measurements recorded simultaneously, from November 9th to December 14th, 1973. The gross evaporation results of the three different types of effluent were compared with each other and with those pertaining to tap water recorded at Port Elizabeth airport over the same period.

RESULTS AND DISCUSSION

The cumulative totals for gross evaporation of water from Class A evaporation pans located at SAWTRI and at Port Elizabeth airport, respectively, during the period 3/10/73 to 6/11/73 are shown in Fig. 1.

It is clear from Fig. 1 that evaporation during the period in question took place at a reasonably steady pace both at SAWTRI and at the Port Elizabeth airport and tended, on average, to be marginally lower at SAWTRI. The average daily gross evaporation during this period was 6,83 mm at the airport and 6,40 mm at SAWTRI. The mean annual gross evaporation at Port Elizabeth airport is 1 915 mm, which is equivalent to about 5,3 mm per day, so that in fact the conditions which prevailed during the course of this experiment were more favourable to evaporation than the average to be expected taken over a twelve month period. (This was due to the fact that this experiment was carried out in summer).

The cumulative totals for gross evaporation of specially prepared scouring effluents in pans located at SAWTRI, and of water in a pan located at Port Elizabeth airport are shown in Fig. 2.

The results obtained for water at the *airport* show that the conditions which prevailed during the course of this second experiment were similar to those which prevailed in the earlier experiment. Not only did evaporation continue at a similar, reasonably steady pace but the average daily gross evaporation was, at 6,22 mm, also more favourable to evaporation than the average to be expected over a twelve month period for this location. From the data obtained from Fig. 1 it would appear

*A petroleum hydrocarbon boiling in the range, nominally 70–115°C

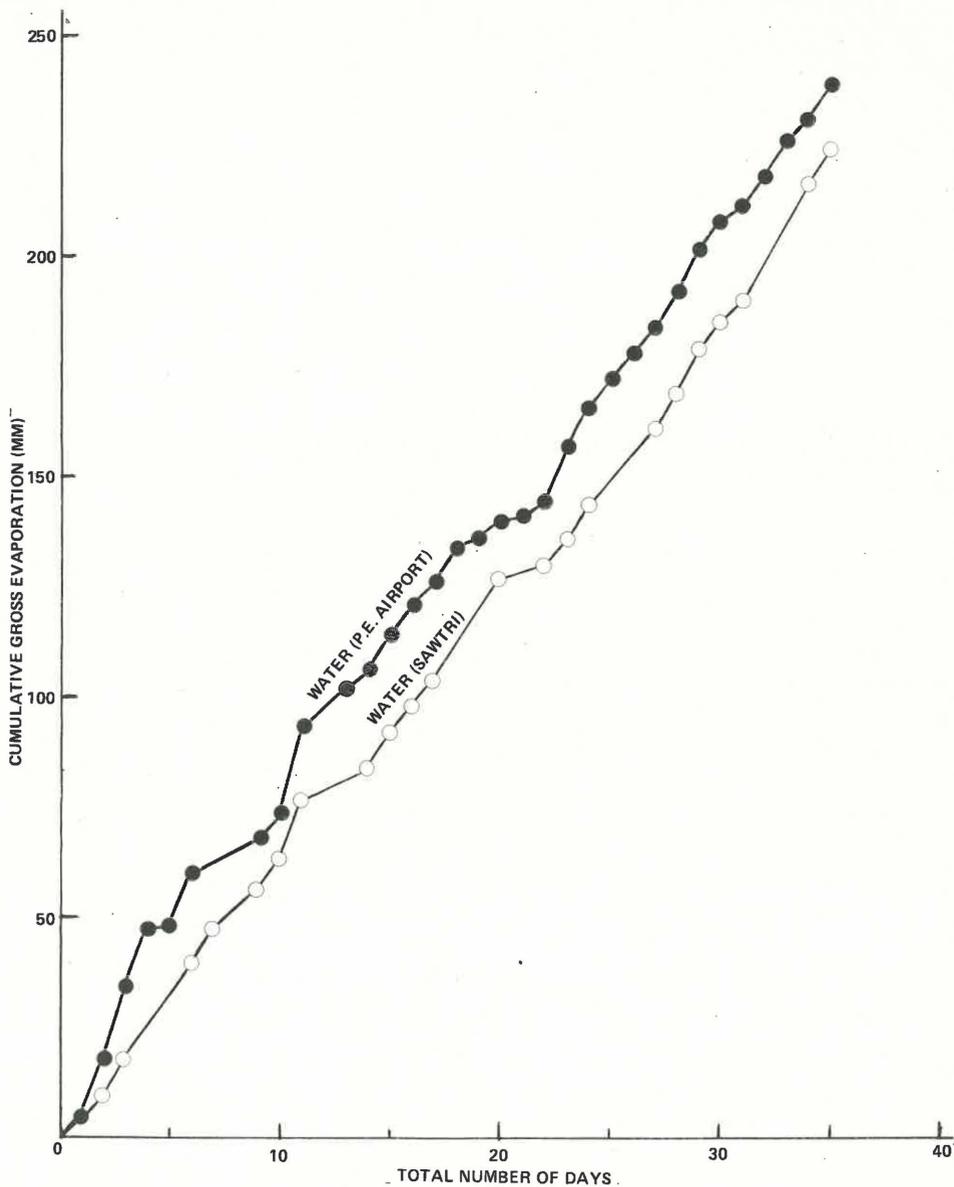


FIGURE 1

Cumulative gross evaporation of Water from Class A evaporating pans at SAWTRI and at Port Elizabeth Airport - Measurements recorded from 3-10-1973 to 6-10-1973 inclusive

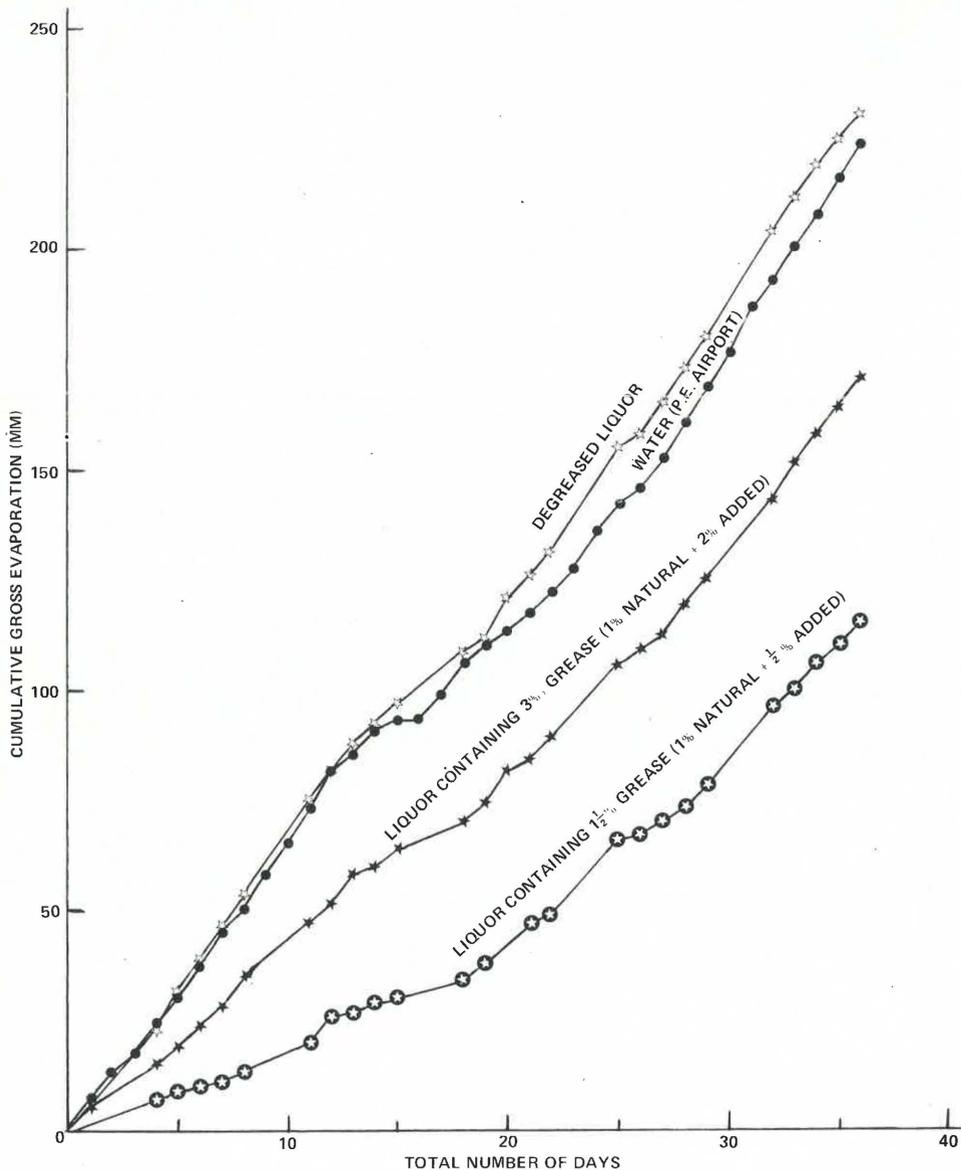


FIGURE 2

Cumulative gross evaporation of Water at Port Elizabeth Airport and of Wool Scouring liquors at SAWTRI from Class A evaporating pans – Measurements recorded from 9-11-1973 to 14-12-1973 inclusive

that the expected average daily gross evaporation for water during this particular period at SAWTRI would have been 5,83 mm.

It is clear from Fig. 2 that the *degreased* liquor evaporated at SAWTRI at a rate which was approximately the same as, or perhaps marginally higher than that of water at the airport. The average daily gross evaporation was 6,42 mm. Since it has been shown that, under similar conditions, water evaporates at a marginally higher rate at the airport than at SAWTRI the apparent difference between the curves for water and degreased liquor illustrated in Fig. 2 would probably be accentuated in practice. The reason for this anomaly may possibly lie in the presence of formaldehyde and dissolved salts in the effluent which may, for example, have decreased the vapour pressure of the effluent.

The curves for the effluents containing *added* grease show that these effluents evaporated at a much slower rate than did the degreased liquor. The average daily gross evaporation in the case of the effluent containing 1,5 *per cent* of grease was 3,22 mm. This was significantly slower than that of the effluent containing 3 *per cent* of grease which was 4,75 mm. This anomaly can be explained, however, by assuming differences in the stabilities of the two emulsions. Whilst both these effluents contained one *per cent* of industrially-acquired grease impurity they also obviously contained a small but specific amount of acquired detergent. When 0,5 *per cent* of recovered wool grease was added in the one case and 2,0 *per cent* in the other case and then emulsified the emulsion produced from the former would be expected to be more stable owing to the relatively greater proportion of detergent present. Further confirmation of differences in stabilities could be found by examining the surface of the liquor in the pans and by determining the moisture content of the supernatant grease layer. In the case of the effluent containing 3 *per cent* of grease the grease layer floating on the surface contained 14,9 *per cent* of water. This layer tended to collect on the side of the tank opposite to the direction of the prevailing wind and occupied an area of perhaps one-third of the whole. In the case of the effluent containing 1,5 *per cent* of grease the grease layer floating on the surface was thinner and contained 38,6 *per cent* of water. This layer also tended to collect on the side of the tank opposite to the direction of the prevailing wind, but in this case it occupied an area of perhaps one-half of the whole. In the case of the degreased liquor a negligible amount of grease appeared to be floating on the surface in the pan, although some grease was found at the bottom of the pan i.e. beneath the liquor, after the experiment had been completed.

Referring once again to Fig. 2, and bearing the above argument in mind, it seems that the gross evaporation rates of the three different types of effluent were governed to a large extent by the fraction of the surface area of the evaporation tank which was covered by a layer of grease, and not necessarily by the amount of grease in the effluent. If the efficiency of evaporation is defined as the rate of evaporation of a particular medium divided by the rate for water under identical conditions and expressed as a percentage we have —

	Approximate percentage of surface area of pan NOT covered with grease (subjectively assessed)	Evaporation efficiency (%)
(a) "Degreased" effluent	100	110
(b) Tap water	100	100
(c) Effluent containing 3% grease (emulsion probably unstable)	67	81
(d) Effluent containing 1½% grease (emulsion probably more stable than (c) above)	50	55

This shows that the efficiency of evaporation tended to be approximately proportional to the percentage of the surface area not covered by grease.

SUMMARY AND CONCLUSIONS

Evaporation experiments using standard evaporation pans were carried out at SAWTRI on different specially prepared wool scouring effluents in an effort to determine if a relationship existed between the grease content of the effluent and the rate of evaporation. Readings for tap water were recorded simultaneously at the nearby Port Elizabeth airport. (This station forms part of a network extending throughout Southern Africa). The results could thus be extrapolated, if required, to provide anticipated evaporation rates elsewhere for similar types of effluent.

The results obtained showed that the efficiency of evaporation (as defined in the discussion) tended to be approximately proportional to the percentage of the surface area of effluent which was *not* covered with grease. This efficiency could be as low as 55 *per cent* for a liquor containing as little as 1,5 *per cent* of wool grease and as high as 110 *per cent* for liquor which has been "degreased". The percentage of the surface area covered with grease, however, was not necessarily proportional to the amount of grease in the effluent. It may well have depended upon the *stabilities* of the emulsions since it was shown that a liquor containing a detergent concentration similar to the first mentioned, but twice the quantity of grease, evaporated significantly faster.

It would seem from the results obtained that mechanical removal of the supernatant greasy scum, or at least constricting it to a smaller confined area, would be of important practical value in increasing the efficiency of evaporation of conventional wool scouring effluents in existing dams. Research into how to treat effluents of this type by other means, in such a manner that the area of supernatant greasy scum is minimised, would be useful.

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