SAWTRI BULLETIN

SOUTH AFRICAN
WOOL AND TEXTILE RESEARCH INSTITUTE
OF THE CSIR

P.O. BOX 1124
PORT ELIZABETH

VOL. 18 MARCH 1984 NO. 1

SAWTRI BULLETIN

VOLUME 18 MARCH 1984 NUMBER 1

CONTENTS

SOUTH AFRICAN
WOOL AND TEXTILE RESEARCH INSTITUTE
OF THE CSIR

P.O. Box 1124
Port Elizabeth

SA ISSN 0036-1003

INSTITUTE NEWS

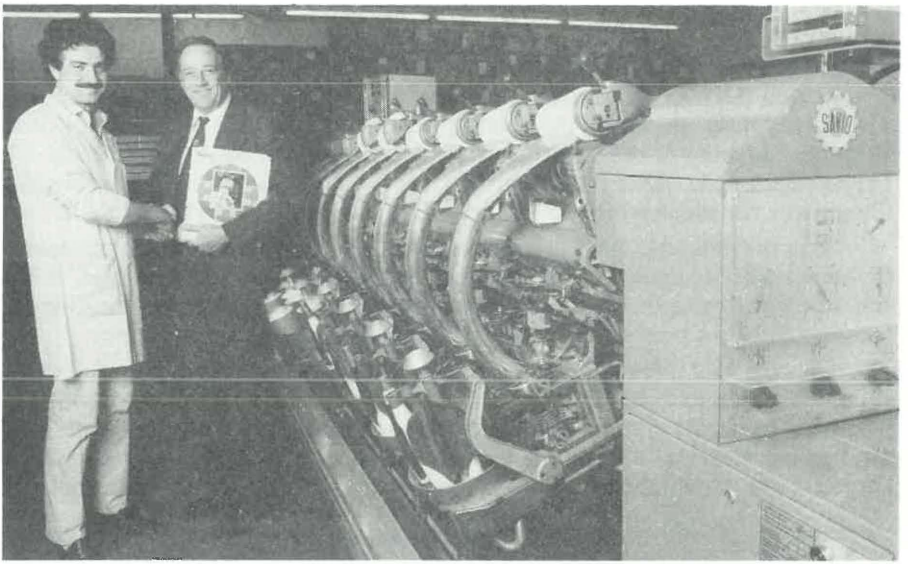
Savio Automatic Winding Machine Installed at SAWTRI

Messrs SAVIO of Pordenone, Italy, a company of the ENI Group, has very generously donated their latest model Mini RAS Automatic Cone Winding Machine to the Institute. During a recent visit to Port Elizabeth, Mr Franco Spironelli, Area Sales Manager for SAVIO handed over the shipping documents for the machine to Dr D W F Turpie, Chief Director of SAWTRI.

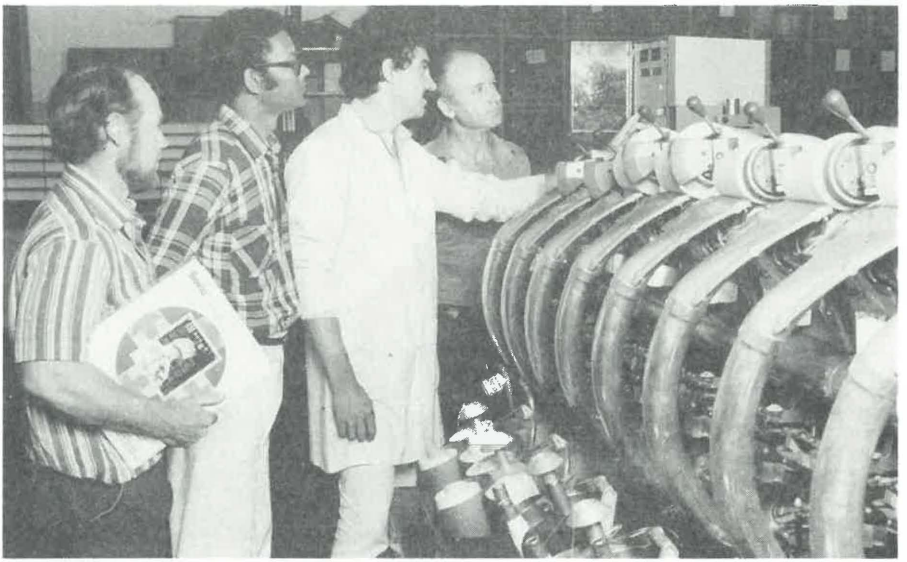
The machine has now arrived and has been installed and commissioned by Mr Joseph Messana, SAVIO's Chief Technician in Southern Africa, in the Institute's yarn preparation department. Mr Messana was also responsible for training Institute personnel in the use and operation of the machine.

The SAVIO Mini RAS Winder is equipped to feed automatically, spinner's tubes and cones of different sizes and can rewind onto cone for purposes of knitting, weaving or dyeing. It contains both electronic and mechanical clearing devices. It is also fitted with two types of automatic knotters, one of which ties weaver's knots and the other fisherman's knots. If

Mr Franco Spironelli, Area Sales Manager for SAVIO handing over the shipping documents for the SAVIO Mini RAS Cone Winder to Chief Director, Dr D W F Turpie with Mr B degli Uberti of SAVIO (left) and Mr M Mayers, Intamarket (Pty) Ltd, (South Africa) (right) in attendance.



Mr J Messana, Chief Technician of SAVIO in South Africa handing over the Mini RAS automatic cone winder to Dr D W F Turpie, Chief Director of SAWTRI.



Weaving staff members, Messrs D Alcock, D Peters and R Ellis, extreme right, being briefed on certain operating aspects of the SAVIO Mini RAS cone winder.

preferred, the yarn can be spliced instead of knotted either by an air splicer or a mechanical splicer. The machine has two types of tensioning devices and is equipped for waxing. The machine is considered to be ideal for yarn preparation for research projects at SAWTRI but will also be available for demonstration purposes and short training courses subject to the requirements of SAWTRI's work and research programme. The donation of this valuable machine is tangible evidence of the esteem in which the Institute is held by this important machine manufacturer with whom SAWTRI already has strong and cordial relations in machine developmental work. We extend our sincere thanks to Dr A Piccinini, President of the SAVIO organisation for their generosity.

Factory visits

Dr D W F Turpie, Chief Director of SAWTRI accompanied by the Group Leader responsible for Industrial Liaison, Mr N J Vogt, visited SAWTRI subscribers and other textile mills in Natal during February and in the Western Province in March. Useful views and information were exchanged and important discussions were held on current and proposed research projects at the Institute.

New Subscribers

We have much pleasure in welcoming the following firms as new subscribers:

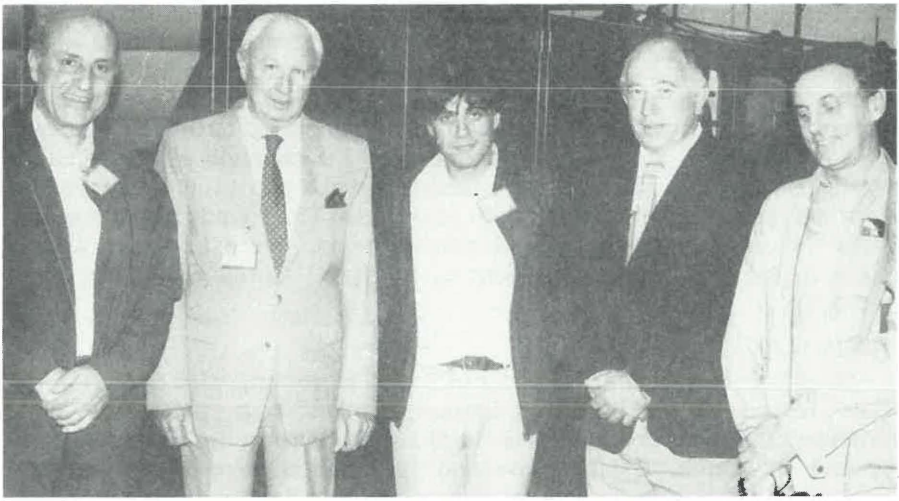
Manufacturas del Domahue SA. Argentine
Meditteranian Woollen Mills, South Africa

Visitors

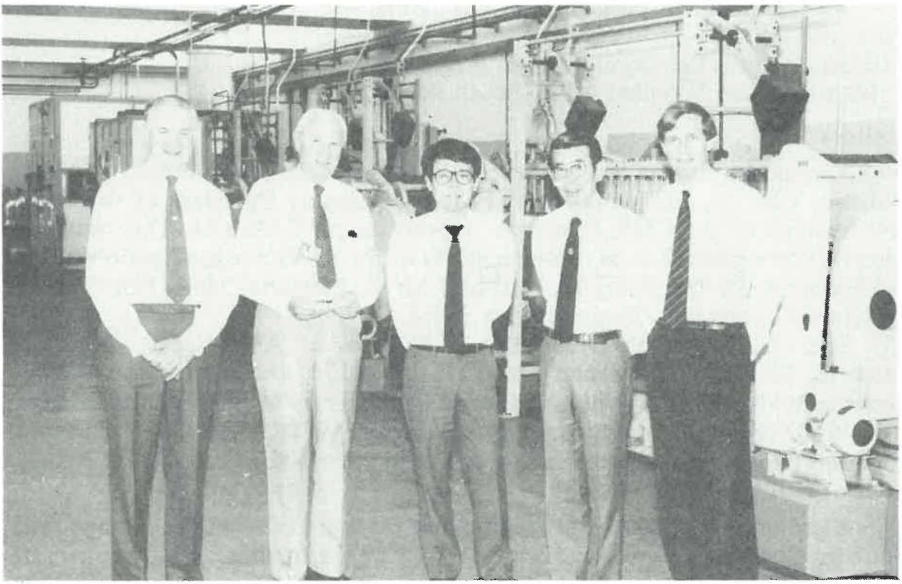
Among the visitors received at SAWTRI since the previous edition of the Bulletin, were the following: Mr J P de Wit, Deputy President of the CSIR and Member of the CSIR Executive responsible for SAWTRI. This visit was preceded by a visit by three representatives of the SAVIO organisation viz. Mr F. Spironelli, Dr Ing B degli Uberti and Mr G. Messana. Mr D Porrit of W Tathams in Rochdale, England, also called.

The Institute received Mr S A S Douglas of AWTA Ltd, Australia recently. Dr Dai Morgan and Mrs E Holsworth of the International Wool Secretariat visited the Institute and was joined later by Mr Peter Smith, also of the IWS. Visitors from Spain came to see SAWTRI. They were Messrs Joaquim Benet i Gibert and Arie Karaso of the firm Kaben SA and Mr Arturo Font of S A Hilaturas Badiella.

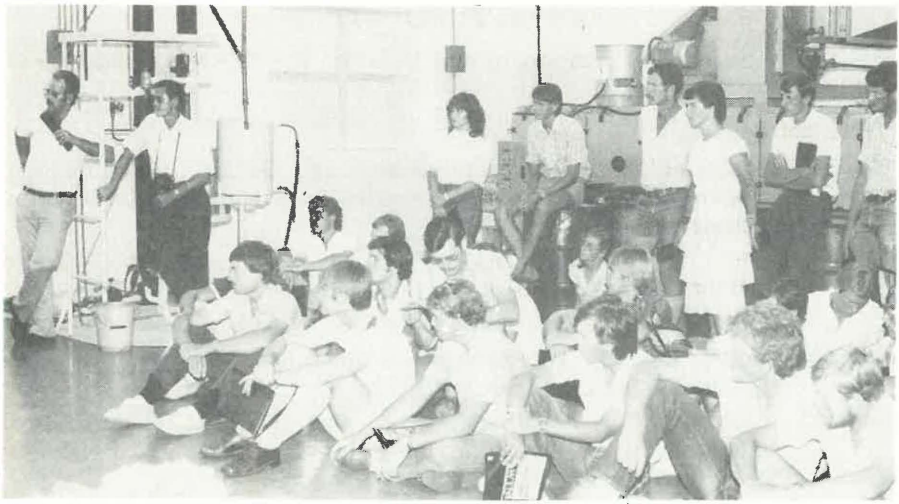
A group of Agriculture students from the University of the Orange Free State in Bloemfontein, were taken on a tour of the Institute. The majority of the students are engaged in studying sheep and wool science and were most interested in the different processing routes for wool and mohair around which much of SAWTRI's research is centered.



Messrs A Font of S.A. Hilaturas Badiella, Spain, N J Vogt of SAWTRI, A Karaso of Kaben S.A., Spain, M Doubell of Cape Produce Co., South Africa and J Benet i Gibert of Kaben, S.A. Spain, during a recent visit to the Institute.



Messrs T Gilson, Mountmellick Textiles Ltd, Ireland; N J Vogt of SAWTRI, Y Ishikawa of Nissho Iwai, Japan, K Kaniguehi of Chuo Woollen Mills Ltd, Japan and P Stucken of Stucken & Co, South Africa, during a recent visit to the Institute.



Agriculture students from the Unversity of the Orange Free State form an attentive audience while aspects of Wool Science are being explained during a visit to SAWTRI recently.

Director Attends International Cotton Test Conference

Dr L Hunter, Director of SAWTRI, attended a meeting of the International Cotton Test Committee in Bremen, Germany on the 29th of February. Dr Hunter is a member of this committee which meets biannually to coincide with the International Cotton Test Conference, which, this year, was held on 1st and 2nd March. Dr Hunter presented a paper "The Influence of cotton Fibre Properties on Certain Properties of Single Jersev Knitted Fabric".

Dr Hunter proceeded from Bremen to Athens in Greece where he had discussions with the President and senior staff of the Hellenic Cotton Board. He also visited a cotton textile mill. Before returning to the Republic, Dr Hunter had discussions with members of the Cotton Production and Marketing Board of Israel.

While in Tel Aviv, he presented a lecture at the Shenkar College of Textile Technology and Fashion on 13th March. The next day took him to Jerusalem where he had discussions with Prof M. Lewin, Director, and Dr Basch of the Israel Fibre Institute. He returned to South Africa on March 21.

"Sympotex '84"

Dr N J J van Rensburg, Group Leader of Wet Processing and Textile Chemistry and Dr F A Barkhuysen, Head of Dyeing, attended "Sympotex '84" in Cape Town on 30 and 31 March. On this occasion Dr Barkhuysen presented a paper: "Radio Frequency Energy Dyeing."

SAWTRI PUBLICATIONS

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

Technical Reports

No. 542 Hunter, L., Kritzinger, Emmerentia and Gee, E., Some Physical Properties of Rotor Yarns, Compiled from Published Information (February 1984)

No. 543 Smuts, S., Hunter, L., and Lombaard, Susanna M., The Effect of Certain Fibre Properties on the Shear Properties of Wool and Mohair/Wool Woven Fabrics (February 1984)

No. 544 Bathie, L.A. and Hunter, L., The Spinning of Fine Wool Noils on the Dref II System (February 1984)

No. 545 Robinson, G.A., Galuszynski, S. and Gee, E., The Effect of Industrial Fusing Conditions on Fabric Shrinkage and Bond Peel Strength (February 1984)

Other Papers

Maasdorp, A. and Van Rensburg, N.J.J. The Relationship between Lustre and the Surface Characteristics of Textile Fibres. Twenty Second Annual Conference of the Electron Microscopy Society of Southern Africa, University of the Witwatersrand, 1983

Van Rensburg, N.J.J., Barkhuysen, F.A. and Maasdorp, A., SEM Studies of Shrinkresist Treated Wool. Twenty Second Annual Conference of the Electron Microscopy Society of Southern Africa, University of the Witwatersrand, 1983.

Barella, A., Manich, A.M., Castro, L. and Hunter, L., El Diametro de Lós Hilos de Continua de Anillos y de Rotor de Algodon: Relacion entre el Diametro y las Propiedades de la Fibra y del Hilo *Revista de la Industria Textil, No. 214/Enero 1984.*

Barella, A., Manich, A.M. and Hunter, L., Relation entre les Paramètres de la Fibre et des Fils de Laine Peigneé et de Mohair et Ceux de la Pilosité Appréciée avec L'appereil "Digital ITQT" *Bull. Scient. ITF,* 12 48, 4 trimestre, 1983.

Van Rensburg, N.J.J. Fire Accidents and burning Textiles, *Journ. Diet. and Home Econ.,* **11,** 1 (1983).

Van Rensburg, N.J.J., Toxicology of Fires and Burning Textiles, *Journ. Diet. and Home Econ.,* **11,** 2 (1983).

A NOTE ON THE NATURE AND MEASUREMENT OF COTTON DUST

by K W Sanderson

INTRODUCTION

This note is not intended to be a complete treatise on the nature of cotton dust and its measurement but rather a brief introduction which may help to stimulate further thought.

The background and development of the cotton dust saga in the U.S.A. is well documented[1,2]. Suffice it to say that, in the end, standards have been imposed at a level which not only may be beyond current instrumentation[3] but also may have surpassed current filtration technology[4].

This note restricts itself to hard fact and offers some selected references for further reading.

> "If gathered and rolled into a ball, the cotton dust standard of 0,2 mg/m^3 of respirable dust would be slightly smaller in size than a typical grain of salt".
>
> McA. Isaacs III

DEFINITION OF COTTON DUST

Cotton dust has been defined by the U.S.A. Occupational Safety and Health Administration (O.S.H.A.) as dust present during the handling or processing of cotton which may contain a mixture of substances, including ground-up plant matter, fibre, bacteria, fungi, soil, pesticides, non-cotton plant matter and other contaminants which may have accumulated during the growing, harvesting and subsequent processing or storage periods[5].

COTTON DUST COMPOSITION

Cotton dust can be composed of a broad cross-section of plant parts, micro-organisms and other mineral and organic matter. Its composition will obviously vary with cultivar, growing and environmental conditions, harvesting method, ginning routine and cleaning and carding procedures. It will change along the processing route, with the heavier particles tending to be eliminated. Table 1 gives some indication of the wide diversity of the composition of cotton dust.

TABLE 1

PLANT AND OTHER MATERIAL IDENTIFIED IN COTTON DUST[6,7]

PLANT PARTS	OTHER MATERIAL
Leaf lamina	Soil and sand
Leaf vein	Fungi
Petiole	Bacteria
Bract	Chemicals
Petal	Insects
Hull, bur, capsule	Weeds and grasses
Seed coat	Weed seeds
Seed endosperm	
Lint fragments	
Sticks and stems	
Bark	

The chemical composition of cotton dust, both inorganic and organic is varied and complex and is beyond the scope of this note. It has been thoroughly researched and reference can be made to Cooke[8] and Booker and Wakelyn[4] for an overview and various other authors[7,9,10,11,12] for more detailed studies.

COTTON DUST PARTICLE SIZE

In terms of dust particle size, the majority of particles in a sample are generally smaller than 15 μm diameter but most of its mass is contributed by those particles larger than 15 μm diameter. In fact, Hatcher, reported by Booker and Wakelyn[4], found that in a typical card room dust sample, 1% of the particles by number and 40% by mass were larger than 15 μm diameter (Table 2).

COTTON DUST LEVELS

Cotton dust levels vary considerably in the various sectors of the cotton industry and Booker and Wakelyn[4] have reported typical concentration levels measured with the vertical elutriator (Table 3):

Dust levels vary widely within any one sector, from work station to work station and from hour to hour. They are lower with spinning than with carding but are usually higher with weaving than with spinning, although the latter is partly caused by the added sizing material.

TABLE 2
PARTICLE SIZE DISTRIBUTION OF VERTICAL ELUTRIATOR COTTON DUST COLLECTED IN A CARD ROOM[4]

Mean particle size 3,2 μm
Standard deviation 3,0 μm
Median particle size (by number) 2,2 μm
Median particle size (by mass) 12,1 μm

Size (μm)	% by number	Cumulative % by number	% by mass	Cumulative % by mass
0	43,23	43,23	0,22	0,22
2	33,41	76,64	4,65	4,87
4	7,86	84,50	5,07	9,94
6	9,14	93,64	16,17	26,11
8	3,34	96,98	12,56	38,67
10	1,52	98,50	10,46	49,13
12	0,64	99,15	7,30	56,43
14	0,23	99,38	4,08	60,51
16	0,18	99,56	4,46	64,97
18	0,06	99,62	2,07	67,04
20	0,15	99,77	7,32	74,36
22	0,06	99,83	3,61	77,97
24	0,07	99,89	5,40	83,37
26	0,03	99,92	2,92	86,29
28	0,04	99,96	4,82	91,11
30	0,02	99,98	4,44	95,55
32	0,01	99,99	2,22	97,77
34	0,01	100,00	2,22	99,99

TABLE 3
TYPICAL COTTON DUST LEVELS (VERTICAL ELUTRIATOR)[4]

Cotton gins	0,5 — 6 mg/m^3
Seed crushing plants	0,6 — 8 mg/m^3
Card room (average)	1,02 mg/m^3
Warehouses	0,2 — 0,4 mg/m^3

To give some indication of the dust levels now required by legislation, the standard as promulgated by the U.S.A. Occupational Safety and Health Administration (O.S.H.A.), is for a maximum allowable respirable cotton dust level of 0,2 mg/m^3 in the opening to spinning areas,

TABLE 4
SOME MAXIMUM ALLOWABLE DUST LEVELS AROUND THE WORLD[14].

COUNTRY	TOTAL DUST (mg/m^3)	RESPIRABLE DUST < 15 μm (mg/m^3)	NOTES
Australia		0.2	1
		0.5	2
		0.75	3
Argentina	1	0.5	
Austria	10		
Belguim	1		
Canada		0.2	1
		0.5	2
		0.75	3
Czechoslovakia	2		
Chile	0.8	0.16	
Colombia		0.2	
Philippines	1		
Finland	1		
France		0.2	
Great Britain	0.5		4
India		0.2	
Italy	1		
Yugoslavia	5	1	
Norway	0.5		
Netherlands		0.2	1
		0.5	2
		0.75	3
New Zealand		0.2	
Poland	4		
Portugal		0.2	
Western Germany	2		
Eastern Germany	1.5		
Rumania	6		
U.S.S.R.	2		
Sweden	0.5		4
Switzerland	1.5		
U.S.A.		0.2	1
		0.5	2
		0.75	3

Notes: 1 In spinning, twisting, winding and warping
2 In opening, beating, carding, drawing, combing, preparation to spinning, and non-textile operations where cotton dust is present
3 In weaving and sizing
4 Without particles bigger than 2 mm

0,75 mg/m³ in the weaving and sizing areas, and 0,5 mg/m³ for other cotton processing operations[5].

In the United Kingdom, the standard recommended by the British Occupational Hygiene Society and adopted by the Health and Safety Executive, is 0,5 mg/m³ of total cotton dust less fly of 2mm and longer[13]. Further cotton dust standards around the world are given in Table 4.

Currently in South Africa, no indication of typical or target dust levels has been given and no legislation exists; however, it is understood that levels are being monitored.

MEASUREMENT OF COTTON DUST

In spite of the large amount of public and private funds spent on technical and medical research[1,15], particularly in the U.S.A., there still appear to be grey areas in the knowledge and understanding of cotton dust and the associated chronic respiratory condition, Byssinosis[16,17]. It is significant however, that dust levels in mills have greatly improved in recent years, not only with the requirement in some countries to meet specific standards but also with the increased awareness of the dust menace and with the installation of new generation "clean" machinery.

However, if one is not already committed to a campaign for cleaner air, the immediate questions to be answered are:

Is there a cotton dust problem?

How serious is it?

Should it be measured and monitored?

In some cases, the problem will be obvious, but very often it will be necessary to measure the level of dust at specific locations prior to recognising and accepting that there is indeed a problem. In any event, dust exclusion or reduction measures are costly and should not be based on qualitative assessment alone. It makes economic commonsense to quantify the problem.

MEASUREMENT TECHNIQUES

1. Basic procedure

Walker and Pardue[18] stressed that both instrumentation and the sampling technique are important if valid analytical data are to be generated and that the two factors are inter-related because technique is partly determined by the capability of the equipment. They listed a basic procedure, outlined in brief in Table 5, which indicates the depth of planning required if meaningless data is to be avoided.

Possibly the most important factor in a monitoring programme is the selection of sampling sites. Positions must not only be where the worker is most likely to be exposed to dust or where dust emissions are high, but they must also take into account atypical conditions such as strong or weak

ventilation air currents and shut-down machinery. In addition, cognisance must be taken of hour to hour and day to day variations in dust levels caused by production changes such as grade of cotton, production speed and ventilation patterns.

TABLE 5
BASIC PROCEDURES FOR COTTON DUST MONITORING[18]

Define process area
Define work areas within each process area
Select and prepare sampling sites
Define employee job classifications
Define time-in-work-areas for each job classification
Obtain production, ventilation and system design information
Clean, calibrate and prepare elutriators, pumps and filter equipment
Obtain 6-8 hour elutriator samples in each work area during each shift of operation
Weigh dust deposits, calculate results, prepare report
Clean equipment for next survey

One can appreciate the need for great care in the interpretation of cotton dust data, no matter how sophisticated the measuring equipment.

It is also worth mentioning that tests, conducted by experts have from time to time shown discrepancies in dust-level readings recorded simultaneously under identical conditions and it may be that, for the moment, the required standards have surpassed the capabilities of available instrumentation[3].

2. Vertical elutriator

The vertical elutriator (Fig 1) has been in wide use for some considerable time and is, in the U.S.A., the standard gravimetric method of cotton dust measurement[18]. It consists of a vertical cylinder, the settling chamber, through which an upward airflow of 7,4 l/min. is passed. This causes dust particles of 15 μm and larger to settle out but allows the smaller dust particles, or respirable dust, to be carried upward and collected on a 37 mm diameter membrane filter of 5 μm pore size held in a cassette assembly. A reliable vacuum pump with gauge, linked to a calibrated orifice in the line, provides the constant airflow from the atmosphere up through the body of the elutriator and on through the filter.

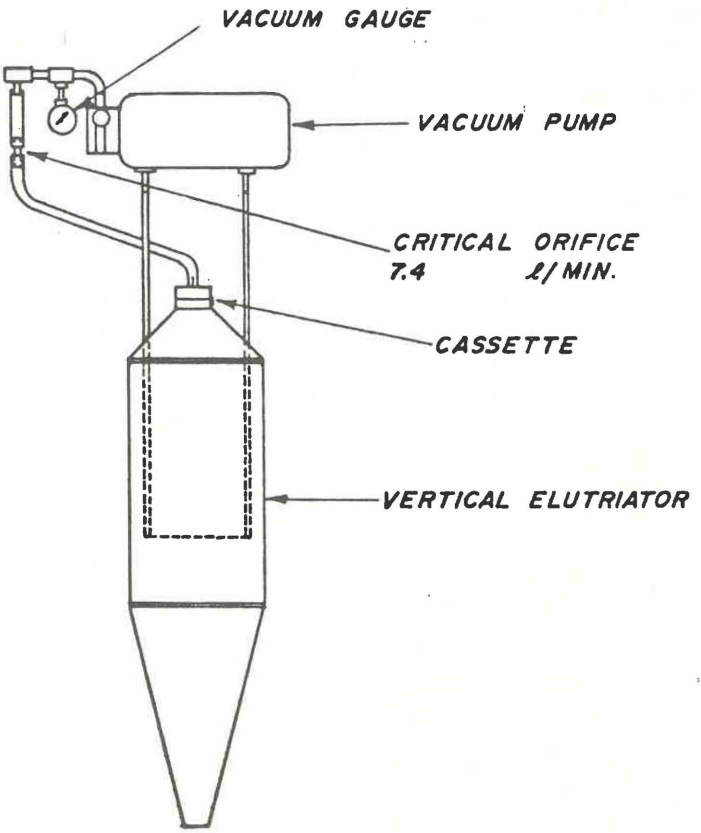


Fig 1: Vertical elutriator schematic

The equipment and its handling are somewhat cumbersome, particularly when a number of them must be sited at selected locations over a minimum period of 6 hours in any one working shift. Because of the very small mass increases involved, the filters must be carefully prepared and delicately handled and the balance must be capable of weighing to an accuracy of 1 μg, or $1x10^{-6}$ gram. This requires special still-air conditions and even heavy breathing can materially affect the result.

In spite of these operational drawbacks, the vertical elutriator has been, and still is, a valuable tool in the evaluation and quantification of atmospheric dust.

3. Continuous aerosol monitor

With today's rapid advances into new areas of technology, new generations of equipment and measuring instruments, exploiting new physical principles, are making their appearance.

For the measurement of dust, mist, fumes and other aerial particulates, there are, for example, the application of light scattering techniques[19,20] and laser technology. The former has been utilised in a fully automatic microprocessor-based electro-optical system, named the Continuous Aerosol Monitor (CAM), or its portable, single sensor version, the PCAM (Fig. 2). This is used with a small vertical elutriator using the low flow rate of 1,85 l/min.

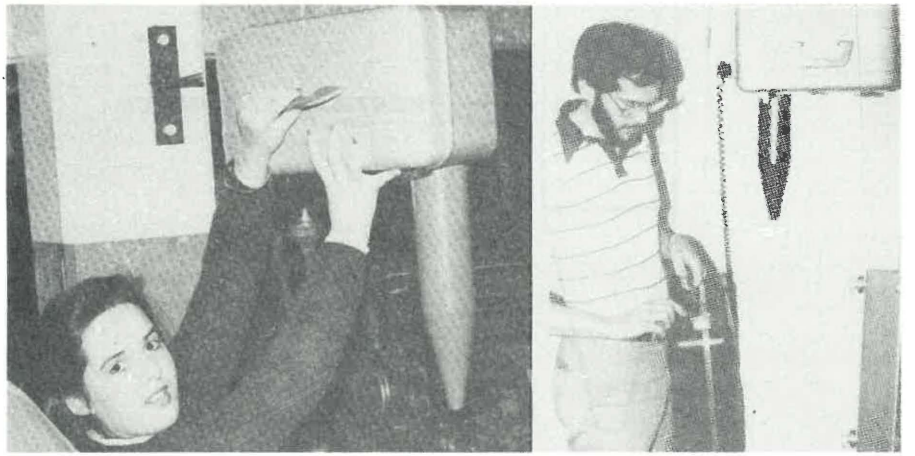


Fig 2: The portable continuous aerosol monitor (PCAM)

Measurements of dust concentration and particle size distribution are made automatically and the data is processed and stored in user-selected periods, and is accessed by direct read-out, print-out or linked to a computer facility. Various accessories are available for ease of data handling and processing. The unit is compact, self-contained, portable and offers unattended operation.

The instrument has been officially evaluated in the U.S.A. and its results have correlated well with the results obtained with the vertical elutriator gravimetric method; it has therefore been approved as a cotton dust sampling technique.

4. Portable Air Sampler

In the United Kingdom, the standard is laid down in terms of "total cotton dust less fly"[13]. This is usually measured gravimetrically by drawing known volumes of air through a 300 mm cube of 2 mm wire mesh gauze, which removes particles larger than 2 mm, the fly, and then on through a glass-fibre filter which collects the dust. The equipment, illustrated in Figure 3, consists of:

- Suction pump with flow-meter, providing airflow of 50—60 l/min.
- Glass-fibre filter, 37 mm diameter
- Cube of 2 mm wire mesh gauze measuring 300 x 300 x 300 mm, with filter assembly set into one face
- Support stand placing sampler at 1,5 m above floor level
- Microbalance capable of weighing a gain of 5 mg to within ± 0,01 mg

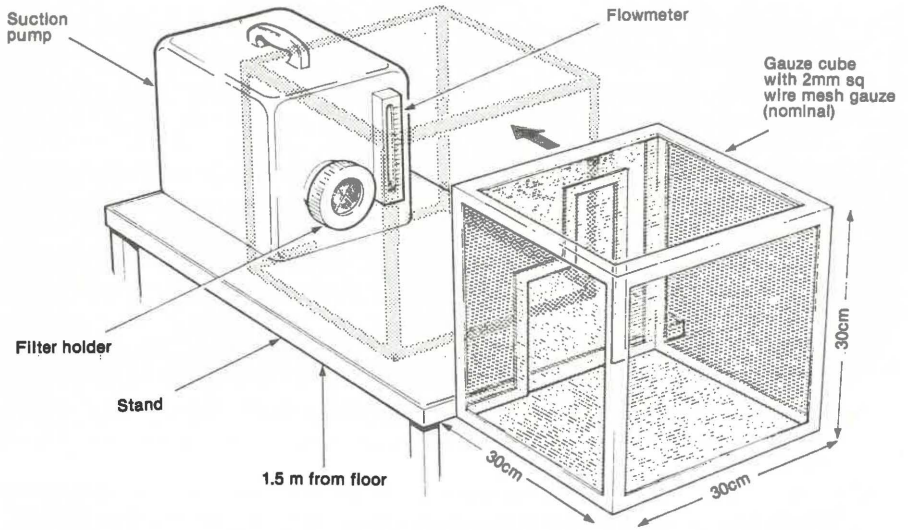


Fig 3: Portable air sampler (U.K.)

The sampling routine is simple and a 3 hr test period would allow some 10 cubic metres of air to be drawn through the equipment.

DUST CONTROL TECHNOLOGY

A selection of references[21—26] are provided for the reader who requires information on more practical aspects of controlling cotton dust.

For general reading:

- Cotton Dust: Controlling an occupational health hazard (Ed. Montalvo J.G.) ACS Symposium Series 189, Washington, 1982.
- Proceedings of Special Sessions on Cotton Dust, Beltwide Cotton Production Research Conferences (annual). National Cotton Council of America, Memphis.

THE USE OF PROPRIETARY NAMES

The names of proprietary products where they appear in this publication, are mentioned for information only. This does not imply that SAWTRI recommends them to the exclusion of other similar products.

REFERENCES

1. Tritsch, J.G., *A historical perspective on cotton dust in the United States textile industry.* In: Cotton dust: Controlling an occupational health hazard (Ed. Montalvo), A.C.S.Symp. Series 189 (1982).
2. — *The OSHA Cotton Dust Standards.* Am. Text., **7** (8), 14 (1978).
3. — *OSHA Watch.* Text. World, 35 (February, 1977).
4. Booker, G.B. and Wakelyn, P.J., *Cotton dust: It's nature and cost of control to 0,2 mg/m³ via conventional filtration technology.* Paper presented at the 14th Int. Cotton Test Conf., Bremen (1978).
5. — *Occupational exposure to cotton dust. Final mandatory occupational safety and health standard.* Federal Register (U.S.A.), **43** (122), 27350-27418, (1978).
6. Morey, P.R., *The botanical origin of cotton dusts.* Proc. Special Session on Cotton Dust, Beltwide Cotton Prod. Res. Conf., Atlanta, (1977).
7. Wakelyn, P.J., Greenblatt, G.A., Brown, D.F. and Trip., V.W., *Chemical properties of cotton dust.* Am. Ind. Hyg. Assoc. J., **37**, 22 (1976).
8. Cooke, T.F., *Chemical composition of cotton dust and its relation to Byssinosis: A review of the literature.* Text. Res. J., **49** (7), 398 (1979).
9. Hedin, P.J., Thompson, A.C., and Gueldner, R.C., *A survey of the volatile constituents of cotton lint and waste with regard to Byssinosis.* J. Agric. Food Chem, **23**, 698 (1975).
10. Brown, D.F., Wall, J.H., Berni, R.J. and Tripp, V.W., *Chemical composition of cotton processing dusts.*, Text. Res. J., **48** (6), 355 (1978).
11. Fornes, R.W., Hersh, S.P., Tucker, P.A. and Gilbert, R.D., *Analysis of the inorganic content of cotton dust: A review.* In: Cotton dust: Controlling an occupational health hazard (Ed. Montalvo), A.C.S. Symp. Series 189 (1982).

12. Fornes, R.W., Gilbert, R.D. and Sasser, P., *Inorganic content of cotton dusts, trash and bracts,* Text: Res. J., **46** (10), 738 (1976).
13. — *Cotton Dust Sampling*. Health and Safety Executive (U.K.). Guidance Note EH25. March 1980.
14. Simonetti, F., *Dust levels around the world.* Am. Text., **13** (1), 14 (1984).
15. Booker, G.B., *OSHA's proposed cotton dust standard: The cost of compliance.* Proc. Special Session on Cotton Dust, Beltwide Cotton Prod. Res. Conf. (1977).
16. — *Byssinosis.* Health and Safety Executive (U.K.), Guidance Note MS9 (December, 1979).
17. Rooke, G.B., *What is Byssinosis? A Review.* Text. Res. J., **51** (3), 168 (1981).
18. Walker, A.L. and Pardue, E.E., *A standardised method for vertical elutriator cotton dust sampling.* In: Cotton dust: Controlling an occupational health hazard (Ed. Montalvo), A.C.S. Symp. Series 189 (1982).
19. — *Equipment for analysing the distribution of particles according to size and for determining the concentration of dust in textile machinery.* Textil. Prax. Int., (9), II and 922 (1978).
20. Shofner, F.M., Miller, A.C., Kriekebaum, G., Kerlin, T.W. and Sasser, P.E., *Electro-optical measurement of cotton dust: an equivalent alternative to the vertical elutriator.* Proc. 3rd Special Session on Cotton Dust, Beltwide Cotton Prod. Res. Conf., Phoenix (1979).
21. Cooke, J.B., *Controlling cotton mill dust levels.* 3rd Special Session on cotton dust, Beltwide Cotton Prod. Res. Conf., Phoenix (1979).
22. Isaacs, McA., *Dust control begins with proper opening,* Text. World, **129** (1), 65 (1979).
23. Lalor, W.F., *Technology for pre-textile cotton cleaning.* In Cotton dust: Controlling an occupational health hazard (Ed. Montalvo), A.C.S. Symposium Series 189 (1982).
24. Leifeld, F., *Dust control in the preparatory operations for spinning.,* Text. Ind. S. Afr., 7 (April 1981).
25. Naarding, B.J., *Microdust elimination from cotton research and developments in machine building.* 14th Int. Cotton Test Conf., Bremen (1978).
26. Weller, H.W., Classen, B.J. and DeLuca, L.B., *New ways of capturing cotton dust.* Text. Ind., **142** (9), 113 (1978).

A NOTE ON THE EXTRACTION OF WOOL GREASE FROM SLUDGE

by T. E. Mozes

ABSTRACT

A laboratory study into the solvent extraction of wool grease from wet sludge (water content about 40%) has shown that 50/50 (v/v) mixtures of dichloromethane with petroleum spirit, n-hexane and benzine yielded, on average, grease extraction levels of 84 to 90%.

INTRODUCTION

SAWTRI has recently been involved in a series of pilot scale investigations[1—3] on the treatment of liquid sludges with a flocculant such as bitterns or magnesium chloride, followed by centrifuging in a horizontal decanter centrifuge. These investigations showed that the solid sludge discharge from the decanter centrifuge, containing about 40% water, was rich in wool grease, typical levels of this component ranging between 16 and 25%. Having such high levels of wool grease present in the sludge, it seemed worthwhile to investigate its recovery by means of solvent extraction. To obviate drying costs it was important that this be done in the wet state.

The solvent extraction of wool grease from wool scouring wastes has been investigated mainly since the early fifties. Various publications on this topic have been referred to in separate reviews[4—6] published recently. It is apparent from these reviews that only limited work has been carried out on the solvent extraction of wool grease from sludge[7—13]. Furthermore, the sludges referred to were normally slurries, i.e. very liquid. In most of the cases[7,8,11—13] a horizontal decanter centrifuge was used to de-water the slurries into a more solid sludge before the sludge was extracted with a solvent. Solvents used included ligroin[7,8], carbon tetrachloride[7,8], trichloroethylene[11,12] and hexane[13]. In some instances[7,8,11,12], water miscible solvents such as isopropanol[7,8] or methanol[11,12] were used in conjunction with these solvents to enable a soap compound to be recovered in addition to wool grease, by distillation of both solvent phases.

SAWTRI decided to investigate the possibility of using a horizontal decanter centrifuge twice in succession, firstly to dewater the slurries in the normal way and secondly, for a two-phase (solvent and sand/water) centrifugal separation with the aim of recovering grease from the solvent phase. To suit this requirement, the solvent selected would need to have a specific gravity lower than that of the sand/water phase produced during centrifuging and it would have to yield preferably two and not three phases. It

was also important, however, to bear in mind the flammability of the solvent for reasons of safety. This report deals with some preliminary results obtained during laboratory trials.

EXPERIMENTAL AND DISCUSSION

Two samples of sludge were investigated, both of which were produced by centrifuging of liquid slurries in a horizontal decanter centrifuge after pretreatment with either 1% (m/v) magnesium chloride or 5% (v/v) bitterns, respectively. The decanter sludge samples contained, on average, about 40% of water and 20% of grease.

The experimental procedure involved mixing of 50 g wet decanter sludge with a suitable amount of solvent (varying between 1 and 3 mℓ of solvent per gram of sludge) by thorough shaking of the mixture for 20 min in a laboratory shaker. Various solvents were selected, namely petroleum spirits (b.p. 60—80°C and 100—120°C, respectively), n-hexane and benzine as well as 50/50 (v/v) mixtures of each of these solvents with dichloromethane. All these solvents produced a clear two-phase separation when mixed with wet sludge and centrifuged in a conventional laboratory centrifuge for 10 min. at 3000 rev/min*. This consisted of an upper solvent phase containing the grease and a lower sand/water layer, which included the total dissolved solids component of the original wastes.

The volumes of both the solvent phase and the sand/water layer were recorded. The grease contents of both the sample investigated and the solvent phase were tested as described previously[14]. The grease extraction level was calculated in each case using the following formula:

$$GE = 100 \left(\frac{V_s C_s}{M_o C_o}\right) \% \qquad (1)$$

GE = Grease Extraction Level (%)
V_s = Volume of Solvent Phase (mℓ)
C_s = Grease Content of Solvent Phase (% $^{m}/v$)
M_o = Original Mass of Decanter Sludge used for Experiment = 50 g
C_o = Grease Content of Decanter Sludge (% $^{m}/m$)

---

*The centrifugal acceleration applied during centrifuging was of the same order as that normally encountered in an industrial co-current horizontal decanter centrifuge, namely about 15 000 m/s^2.

The grease extraction level was found to vary only marginally with the ratio of solvent to sludge. The average values obtained for each solvent (or solvent mixture) investigated are given in Table 1, which shows that the presence of dichloromethane resulted in a significantly increased grease extraction level. Considering both sludge samples investigated, this increase was, on average, from a grease extraction level of 60 to 66% for the individual solvents to a level of 84 to 90% for solvent mixtures, the presence of dichloromethane in the solvent mixture thus being responsible for an average increase of 24% (in absolute value) in the grease extraction level.

TABLE 1
GREASE EXTRACTION LEVELS FOR VARIOUS SOLVENTS AND SOLVENT MIXTURES

Sludge Sample	Average Grease Content (%)	AVERAGE GREASE EXTRACTION LEVEL (%)							
		Petroleum Spirit (b.p. 60 – 80°C)	Petroleum Spirit (b.p. 100—120°C)	n-Hexane	Benzine	Petroleum Spirit (b.p.60 – 80°C) + Dichloromethane	Petroleum Spirit (b.p.100 – 120°C) + Dichloromethane	n-Hexane + Dichlor-oromethane	Benzine + Dichlor-oromethane
A	23,0	60	61	56	56	88	86	82	85
B	18,2	70	70	64	68	92	88	95	83

ACKNOWLEDGEMENTS

The author would like to thank Drs D W F Turpie and N J J van Rensburg for valuable advice and Messrs E F Pretorius and S A Musmeci for technical assistance.

PROPRIETARY NAMES

The names of proprietary products where they appear in this publication are mentioned for information only. This does not imply that SAWTRI recommends them to the exclusion of other similar products.

REFERENCES

1. Mozes, T. E., van Rensburg, N. J. J. and Turpie, D. W. F., *SAWTRI Techn. Rep.* No. 467 (1981).
2. Mozes, T. E., van Rensburg, N. J. J. and Turpie, D. W. F., *SAWTRI Techn. Rep.* No. 468 (1981).
3. Mozes, T. E., van Rensburg, N. J. J. and Turpie, D. W. F., *Water, Sewage and Effluent,* **5**, 5 (1981).

4. Stewart, R. G. and Story, L. F., *WRONZ Technical Papers,* Vol. 4 (1980).
5. Gibson, J. D. M., Morgan, W. V. and Robinson, B., *Wool Sci. Rev.,* **57** (1981).
6. Mozes, T. E., *SAWTRI Special Publication* (1982).
7. B.P. 1 128 921 (1968).
8. U.S. Patent 3 436 342 (1969).
9. U.S. Patent 3 642 137 (1968).
10. B.P. 1 298 878 (1972).
11. McCracken, J. R., Chorley, G. and Chaikin, M., *Proc. Fifth Aust. Conf. Chem. Eng.,* Canberra, Australia (1977).
12. McCracken, J. R. and Chaikin, M., *Text. J. Aust.,* 4/5, 5 (1978).
13. Brach, J., Dewez, J. and Rousseau, L., *Proc. Int. Conf. on Solvent Extraction* (1980).
14. Veldsman, D. P., *SAWTRI Techn. Rep.* No. 5 (1952).

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.