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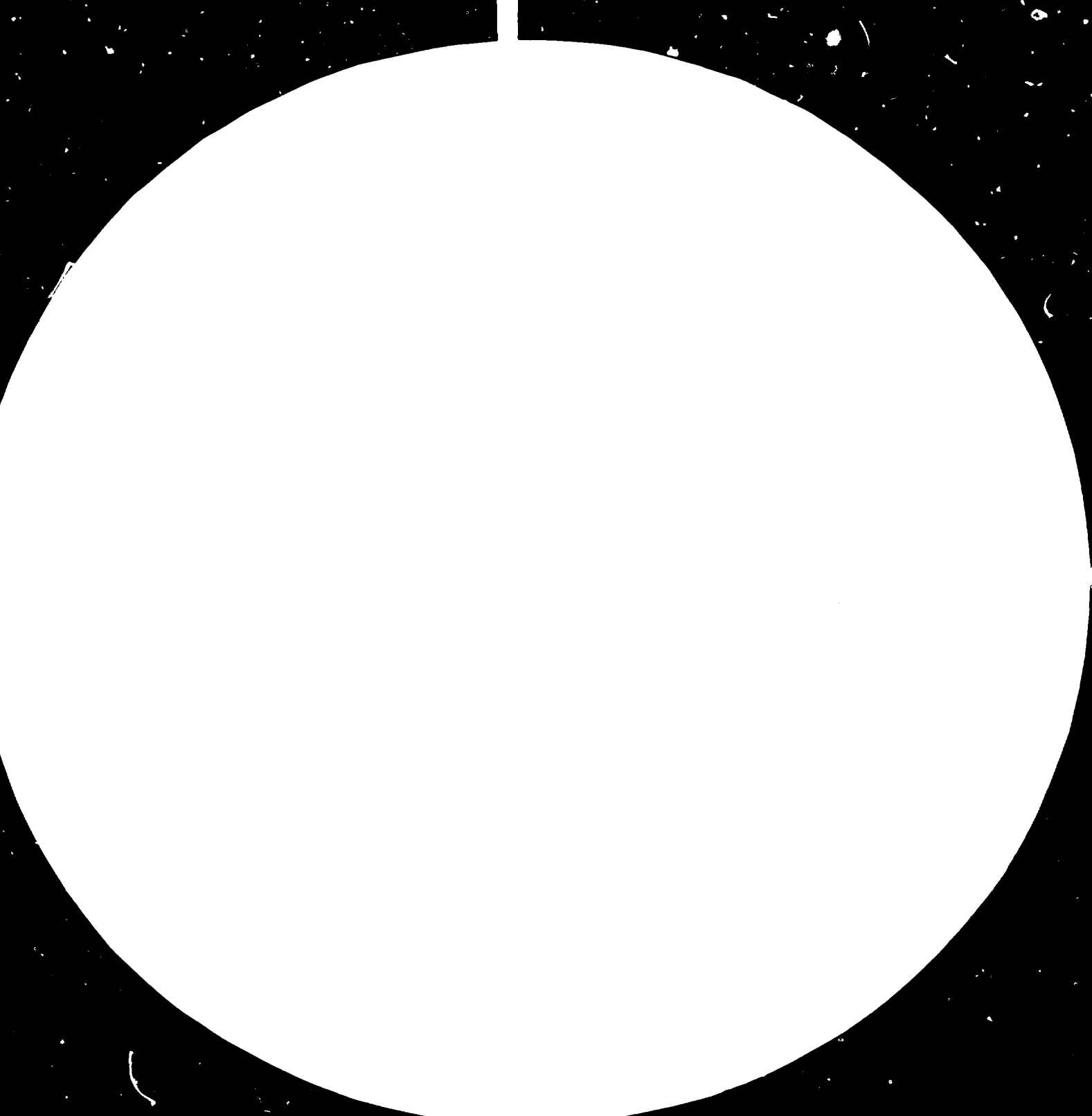

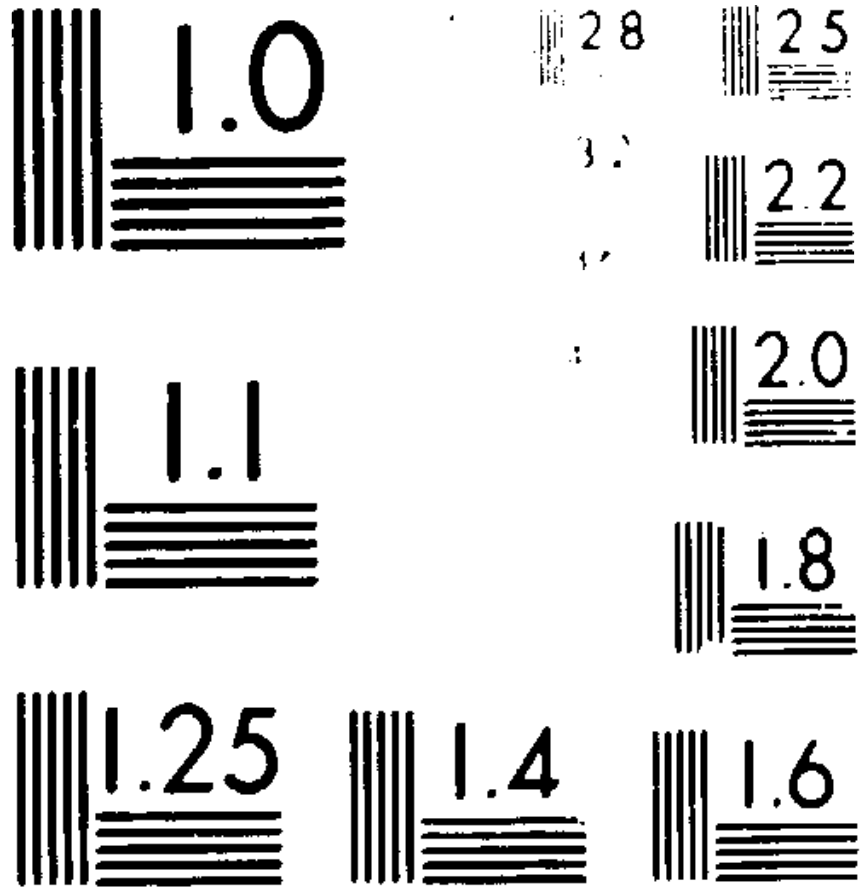

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DP/ID/SER.A/364
4 February 1982
ENGLISH

DEVELOPMENT OF THE HOSIERY KNITWEAR INDUSTRY, LUDHIANA (PUNJAB)

DP/IND/73/021

INDIA

Technical report: Development of the hosiery knitwear industry, Ludhiana (Punjab)

Prepared for the Government of India
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of G. Meier,
expert in textile dyeing and finishing (wet processing)

United Nations Industrial Development Organization
Vienna

V.82-21390

Explanatory notes

The following abbreviations are used in this document:

BASF	Badische Anilin und Soda Fabrik
IWS	International Wool Secretariat
PVC	polyvinylchloride
SR	shrink-resistant

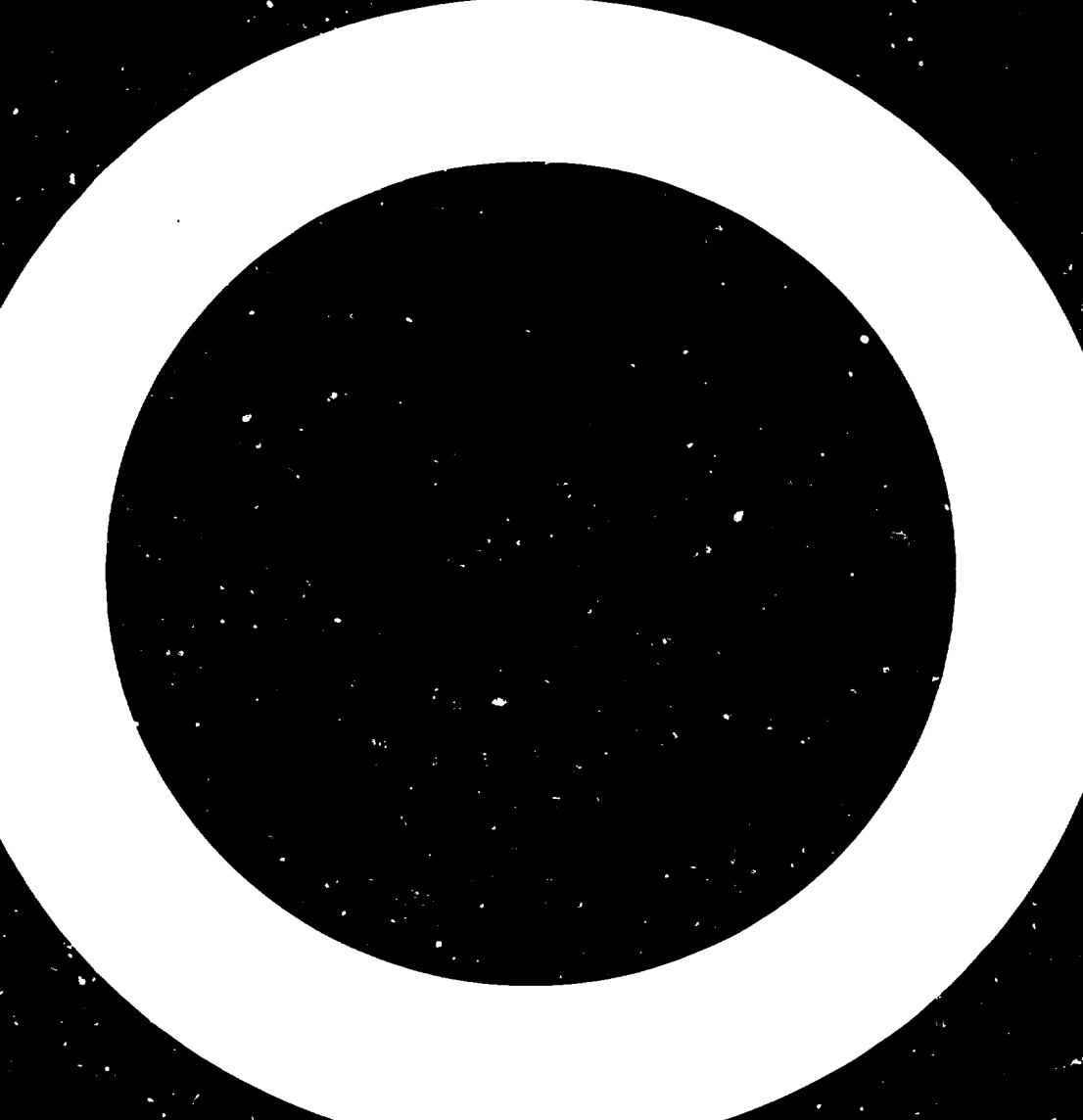
ABSTRACT

As part of the United Nations Development Programme (UNDP) project "Development of the hosiery knitwear industry, Ludhiana (Punjab)" (DP/IND/73/021), an expert in textile dyeing and finishing was sent by the United Nations Industrial Development Organization (UNIDO), executing agency for the project. to Ludhiana for two months at the end of 1981. The expert visited various dyeing and finishing plants in Ludhiana (Punjab), and found their machines and equipment in an unacceptable condition. The selection of dyes was unsatisfactory. The dissolving of dyes was performed in rusted steel drums and mixing was done by hand. Weighing was done on inaccurate hand-weighing machines. This all led to uneven results.

The finishing of cotton and blends was of a low standard because the dyed fabric was dried in the open sun. Advice was given on dyeing and finishing of polyester and acrylic wool.

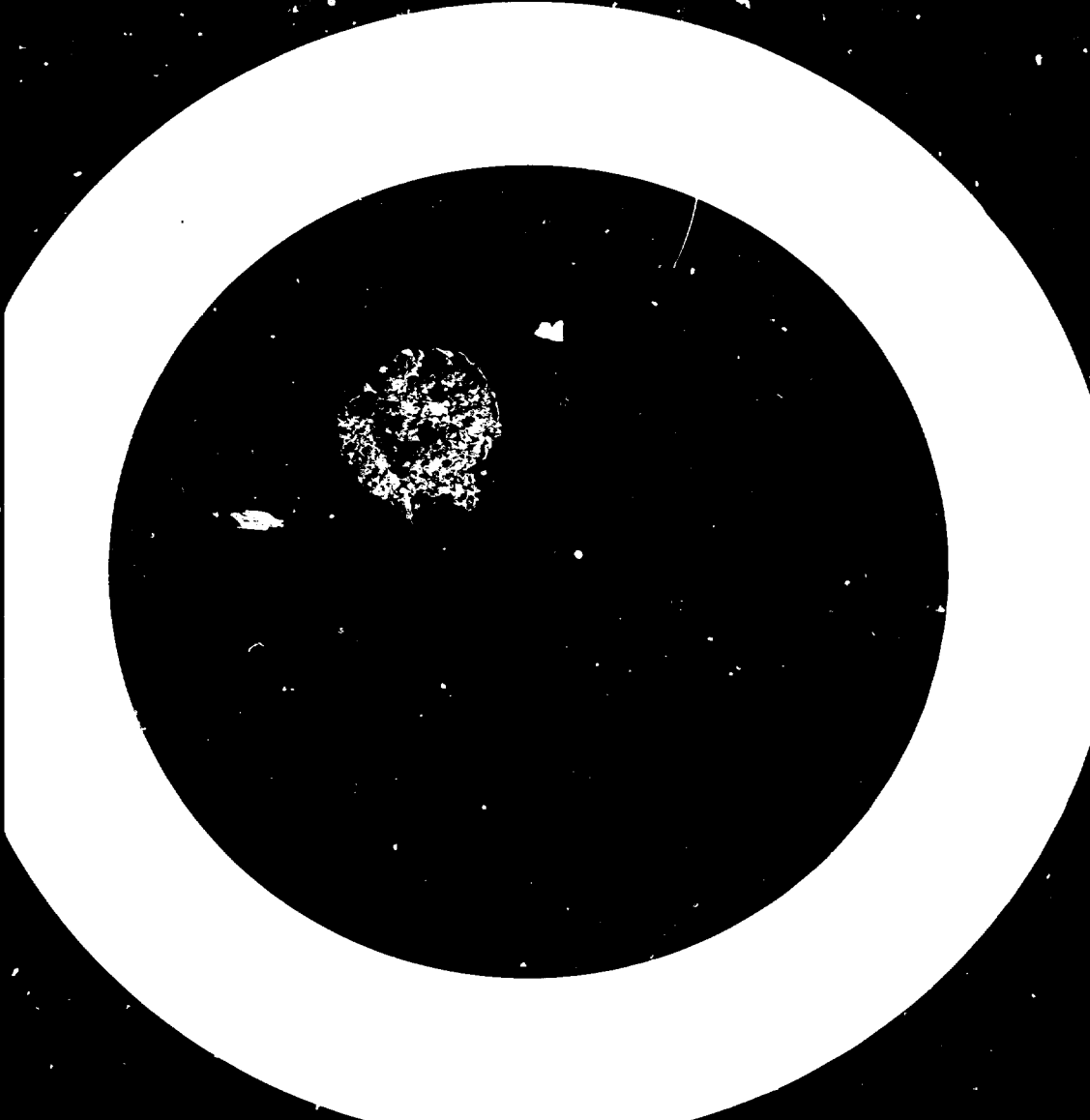
Problems in colour fastness, colour bleeding, dyeing of polyester and blends etc. were discussed, and advice was also given to their experts on these matters. To obtain the best results in package dyeing it was important to produce sun cheeses of even tension.

Shrink-resistant (SR) treated fabric is not presently in demand because of its high cost. This can be overcome by making use of aqueous and padding treatment processes. Various trials have already been carried out to demonstrate how to produce low-cost SR treated fabric.



CONTENTS

Annexes



INTRODUCTION

As part of United Nations Development Programme (UNDP) project "Development of the hosiery knitwear industry, Ludhiana (Punjab) (DP/IND/73/021), an expert in textile dyeing and finishing (wet processing) was sent to Ludhiana by the United Nations Industrial Development Organization (UNIDO), executing agency for the project, for two months at the end of 1981.[1/] The expert visited various knitwear and related factories in Ludhiana (Punjab), and this report tells of his findings and offers technical advice on how the quality of wet processing can be improved.

A list of recommended spare parts and chemicals is given in the annex II.

1/ See job description, annex I.

FINDINGS AND RECOMMENDATIONS

The expert made several visits to dyeing and finishing factories in the Ludhiana district which revealed technical and machinery standards in an unacceptable condition.

The mechanical condition of processing equipment for dyeing and finishing has a direct effect on production results as a result of the following factors:

(a) Maintenance of machinery was low and generally completely ignored;

(b) There were neither dye buckets nor electrical stirrers;

(c) Shortage of steam supply during dyeing was often the case; the situation with respect to the electricity supply was also poor.

Finishing of garments and panels

Garment finishing operations with synthetic turpentine left the fabric with a repulsive odour with the result that the garments were not acceptable for export.

This problem was discussed with the knitwear facility management before trials to find a solution were made.

The management's attitude was that the use of perchlorethylene and of sophisticated machinery was a costly operation which companies would not afford, since they are already working on low profit margins.

Improvement and recommendations

One way of overcoming the cost problem was grading and sorting garments into two categories:

(a) Clean panels and garments would be steamed and finished only at the customer's request;

(b) Heavily stained garments and panels would be spotted and scoured with perchlorethylene. Trials were conducted at the Knitwear Facility and the method was acceptable and will be continued.

The Knitwear Facility encountered a number of problems in finishing garments and panels in solvent scouring and milling for local mills. This treatment also appears to be a most difficult operation for the small-scale knitters. The expert investigated the nature of the problems and came to the following conclusions:

Findings

(a) Ends of separately knitted panels were generally not reinforced;

(b) Stitch running and tangling in the machine was a problem because of fabric distortion;

(c) When the scouring and milling process was finished, the items which were ready to come out of the machine turned into fabric balls;

The following results were encountered:

(a) Fabric and panels became undersized through tension and force by entangling, and had a severe effect on even milling results;

(b) Loss of garment and panel weight by poor stitch formation.

Recommendation

The only way to overcome this problem was to load garments and panels into polyamide/polyurethane bags so as to give support to the knitted goods and prevent entangling. This was also recommended for processing in side-paddle machines. Even milling results are obtained. Knitters have been advised to knit panels one size larger. This allows for natural shrinkage in scouring and milling.

Trials at the Facility have since taken place with these knitting improvements. The result has been that the control of weight has been stable, while the problem of entangling and distortion should be overcome when the polyamide/polyurthane bags are available. Some of these bags will be sent from New Zealand shortly.

Milling trials have been undertaken on garments, panels and blankets to test the dye fastness in the solvent scour.

Tests for maximum blanket shrinkage after milling have also been conducted. The processing and final finishing of blankets is well accepted and further trials will be made shortly by the same company on acrylic blankets.

Finally, tests have been conducted in different methods of milling hank yarn and acrylic yarn.

I. FINISHING AND EXPORTING GARMENTS

Object

The objective of the programme was the reproduction of overseas samples in Ludhiana for export purposes.

Unfortunately, the samples given to the manufacturer by the overseas buyer were reproduced badly and problems occurred as a result in finishing at the Knitwear Facility.

Finding

The sample had been made out of top dyed yarn; the weight of the sample finished garment was 250 g. The garments reproduced in Ludhiana, and given to the Facility for solvent scour and milling, were underweight by 10-15%.

Reason

The Ludhiana garment was made from yarn dyed wool. The wool had been wound, dyed and back wound on cones. As a consequence, the wool lost one count, this amounted to 10-15%.

Natural fibre cannot be forced in order to bring the weight up by over-milling; if it were forced the garment will shrink to excess and will felt up.

Advice to knitting master

The knitting tension should be increased to bring the weight up; in addition, the size of the garment should be one size larger.

This advice has proved correct. Garments have turned out to be in the same condition, and the finishing at the Facility has proved no problem. The export order is now in process.

Chlorination of wool

Hand and machine washability

The process with Basolan DC which is widely known to the textile dyers and is locally available proved to be excellent.

Winch-becks and side-paddle machines give the best result in garment form. As far as the garment process in side paddle is concerned, polyurethane bags should be used.

Chlorination of cheeses

This process has the disadvantage in that uniform chlorination before dyeing is possible only under extremely favourable conditions. The liquid circulates more intensively than it does in dyeing, and predominantly from the outside towards the centre. The pH should be adjusted as with hank yarn.

The process is less critical for dyed goods, except for pale or chlorine-sensitive shades.

Chlorination-Hercosett process for tops

This process is required for machine washability to obtain widespread acceptance among manufacturers. The process can fit into the production sequence at any point. Wool can be treated either continuously before spinning, or batch-treated in garment form as with chlorination of wool. The processing sequence for wool continuously, plus the resin technique (the chlorine-Hercosett process) consists of:

Chlorination
Neutralization
Resin application
Softener application
Curing of the resin

This process is carried out on wool tops continuously through a four-bowls machine.

Tests have been made on sample loads weighing 5 kg to 10 kg by the solvent spray method. Wash tests have given good results.

Remarks

The modification of the SR treatment over the last few years by resin batch application, padding and heat curing is simple; it is a cheaper process for the treatment of woven or knitted fabrics from woollen or worsted

spun yarns, with a soft acrylic polymer and a polymer cross-linking agent, to give a high degree of resistance to felting shrinkage.

The finished fabric has a soft handle, good pill resistance and smooth properties.

Neither prior chlorination nor washing off is necessary. The product can also be used on polyester for anti-pilling in a different solution. Fabrics and garments which the expert brought from New Zealand were washed for 60 minutes and were tested at the Knitwear Facility. They passed the International Wool Secretariat (IWS) standard.

A detailed description of methods for milling and chlorination is given in annexes III and IV.

II. DYEING IN THE MILLS

During the expert's visit to the Ludhiana district's several dye houses he studied the problems and results of dyeing on all kinds of fabrics and blends.

The Knitwear Facility management requested technical advice, suggestions for the improvement of machinery, dye-bleeding as well as general ideas and help in the construction of dye houses.

Findings

Fabric was run up to two days in the winch to get the required shade.

Winch speed was slow, and steam and water valves did not operate efficiently.

No dye-dissolving equipment was available; rusted steel drums were in use.

Maintenance of machines was poor, steam supply was short.

No suitable dye scales were available, only a hand scale was used. Dyes had to be mixed by hand.

Dye cards for record purposes and formulation did not exist.

Improvements to fastness

Trials were made immediately to improve dye fastness on red, brown and navy shades.

The tests were successful with the same product, only dyeing techniques and formulations were altered. This was explained to the dyer.

Other improvements

The dyeing time was reduced to 8 hours.

Winch speed was increased and resulted in a better level by changing the motor pully.

New plastic buckets and dippers were purchased.

Maintenance was carried out on the machines by adjusting the steam and the water valve.

Dye cards for recording purposes have been prepared.

Dye scales will be obtained. The company is now installing a dye mixer.

Further trials have been made in changing from cold reactive dyes to hot dyes.

Advantages

Advantages include lower costs (one third) for dyestuff.

Better repeatability.

Rematching of the shade range is progressing with the help of the Knitwear Facility dye-laboratory.

Acrylic piece dyeing

Findings

The main problem was that dyeing was uneven, water, steam condensation and winch creases, there were also problems with fabric speed and the mechanical condition of the machines.

Improvement

Tests were undertaken to dye the fabric without pre-steaming in order to prevent marks from water condensation. A further series of tests was also made in steaming the fabric on a calender. The first test proved to be the most effective. No spots were visible, and dyeing was even.

Acrylic fabric dyed on winch-becks must always be cooled to about 50°C before it is removed from the dye bath. This prevents crease and rope marks. Cold water should not be added too quickly to cool down the fabric.

After these tests the fabric was found to be dyed satisfactorily. An expert from the Knitwear Facility was in attendance at the tests.

Recommendations

Unlike polyesters, pre-setting of acrylic material is not possible since such fibres and fabrics cannot be heat-set because of their chemical structure.

At the request of the management, advice was given on future installation of new machinery suitable for jet dyeing of acrylics. Advantages included: low liquid ratio and low steam and water consumption. It is fortunate that jet dyeing machines are manufactured in India. However, trials on bank dyeing of acrylic should be carried out before decisions on the purchase of jet dyeing machines. No major problems were expected, except in bleached fabric where "optical white" chemicals are used (see annex V).

III. DYEING AT THE KNITWEAR FACILITY PREMISES

Package dyeing

Irregularity in cone winding and uneven yarn showed up strongly in package dyeings when two-fold yarn was dyed.

Dye-bleeding occurred in colours such as maroon, red, bottle-green and navy. There were dye spots and uneven dye affinity. Productivity was low.

Improvements

The irregularity in the cone-winding department must improve as it has a direct effect on dyeing. To overcome this problem it is necessary to instal electronic clearers. Better stock recording would save a lot of redyeing. The dye spots and unresolved dye problems have arisen from not using a levelling agent. The standard chemical D.A. was run down, the use of a substitute, Lyogen S.M.C. caused the problems. The dyeing result has been good since D.A. was in use. Dye-bleaching problems will only be solved after Uniperol SE arrives.

Hank yarn dyeing

The results of hank dyeing were good. The unevenness in yarn showed up in knitting and it should be noted that this was not a dyeing fault.

Productivity

It was observed that supervision of staff was poor and labour was not under control. The dyehouse laboratory is important for customer service. Therefore, the daily return of samples is vital and should be improved, but needs better supervision.

Recommendation

A blackboard should be placed beside each machine and instructions written on it in a way that the operator is able to follow them correctly.

This will help avoid mistakes and other problems in dyeing; it will also help the dyeing master to control staff and increase production.

Rust marks on hank-dyed material

The expert recommended to the Knitwear Facility engineer to cover the steel trolley frames and handles with polyvinylchloride (PVC) sheet in order to prevent rust marks from the trolleys.

Dyeing with Acidol M dyes

Scour first with non-ionic detergent	1%
Two rinses	

Fresh bath

Set pH with acetic acid	4.5
Add Uniperol SE	1 - 1.5%
Glauber's salt	5%

Add dissolvent acidol M dye to the heated 50°C dye-bath. Let it run 15 minutes
Raise to the boil for over 40 minutes
Dye sample for 60 minutes

Hank-yarn dyeing

Use above formula.

Dye-fastness to washing and solvent scour and milling

Dye-bleeding is improved by the selection of dyestuffs and applying new techniques for dark colours such as maroon, red, bottle-green and navy. The Knitwear Facility has a good range of dyestuffs in stock; the range of dyes guarantee maximum fastnesses. About 200 kg of different Acidol M dyes for wool and wool/nylon have been provided by UNIDO. However, these dyes cannot be used without the recommended levelling agent Uniperol SE. Since equivalent products are not available, Unipersol SE should be imported.

It is recommended that 100 kg to 200 kg of Uniperol SE be purchased from BASF through UNDP/UNIDO, so that the dyes in stock could be used, in particular for dyeing of knitwear for export.

This is an urgent recommendation in view of the fact that the Knitwear Facility has large orders affected. It is believed that Acidol M dyes will soon be produced in India, thus overcoming the problems of importation.

IV. FUTURE INVESTMENTS

To improve service, productivity, technology and efficiency as well as to reduce costs, the following machines are required:

(a) One winch-back with a capacity of 100-150 kg for scouring and dyeing. This is available locally;

(b) One jet-dyeing machine for dyeing fabrics such as polyester and blends, and nylon and blends. The high-temperature jet drying machine needs to be equipped with an overflow adjustment for dyeing wool. The fabric capacity of the machine is 100-150 kg, liquor ratio 1-6-1-8;

(c) One Stenter for fabric finishing in open-width form, maximum width 200 cm, for finishing all fabrics in open width. Finishing of SR treatment by heat curing, this process is necessary for export purposes and for drying of flame-proof treated fabric. The Stenter must have a minimum of either two heating bays and one cooling bay or three heating bays and an air-cooling fan. A thermo-pack and a front-steaming device are also needed; the maximum heat requirement is 200°C, and both are available locally;

(d) One decatizing machine for the final finishing of wool, SR treated fabric and garments. This machine must be imported and should have a working width of 180 cm;

(e) One paddle machine with a maximum width of 180 cm; it should have a compensator attachment. This machine will be placed in front of the Stenter with an interlooking device for finishing SR treated fabrics, with flame-proof applications. This treatment is important for cotton goods. Flame-proof treatment for cotton and other materials will shortly become legally necessary;

(f) One express unit (calender) for finishing all kinds of fabric in tubular form. A Pegg machine is recommended.

V. TECHNICAL ADVICE

The technical knowledge of the staff in the Knitwear Facility is of a high standard, and they have experience in dyeing, finishing, quality control and cone winding.

They are well accepted in the Ludhiana district, and are able to give advice and help the local industry with problems in dyeing, wet and dry finishing, winding and quality control.

At the request of the managers in the Ludhiana district, the expert gave advice on the machines needed to increase productivity, cost saving and profitability.

The machinery needs of the Knitwear Facility have been explained earlier, and urgent needs were discussed by the expert with the Facility's managing director.

VI. TECHNICAL EXPERIENCE

The expert met with the workers, proprietors, managers and technicians in the Ludhiana district, all of whom had different levels of technical knowledge and information with respect to their work.

A further effort should be made by the Knitwear Facility to make contact with the workers and disseminate information at all levels through lectures, seminars, visits and newsletters. After studying the method of operations in the industry in Ludhiana, the expert suggested that a technical association of dyers and finishers as well as management be formed.

The aims and purposes of such a body should include discussing and following up on problem of the industry and seeking solutions through the exchange of, technical information obtained either through visits outside the country or through trade journals.

Some of the problems can be solved with government assistance or through other agencies. The technical association should meet at least once a month, perhaps on a Saturday, with an expert from the Knitwear Facility acting as Chairman.

Similar associations in other countries have proved to be quite successful. The expert will be pleased to offer further advice in this respect if required.

Name of company Date of visit.	Basic production type of market.
Oswal Woollen Mills, Plant I 12.11.1981 More visits have been made to follow up the improvements with the technical staff of the Facility.	Dyeing of cotton, cotton blends. Machinery in bad condition. No equipment for dye preparation in any way of processing.
Oswal Woollen Mills, Plant II 29.10.1981	Garment knitters for export USSR. Blankets made out of wool/acrylic. Very old equipments for blankets.
Kesho Ram Ashoka Dyeing Finishing Mills 30.10.1981 Visits have been followed up with Facility Staff on different dates.	Garment maker fabric for export. Fibre mainly in cotton and acrylic. Locally made equipments. Dyeing any kind of fabric.
Vardhman Spinning and GeneralMills, Plant I 6.11.1981 Visits have been followed up.	Main production in dyeing of acrylic fiber. Very good dyeing machinery. No drying capacity for the bulk dyeing.
Vardhman Spinning and Generall Mills Ltd., Plant III 6.11.1981	Garment knitter for export. Machines mostly hand operated and some automatic.
This visits to the company have been followed up on different dates with the Staff of the Facility.	
Rajan Puri Tecknits 20.10.1981	Knitters of wool and acrylic. Making of garment in panel form
Devoak Dumra Grontway, Manufacturers Exportors. 22.10.1981	Spinners, knitters, top making and chlorination of wool.
Rajan Puri Tecknits 24.10.1981	Knitters of wool and acrylic-Making of garments and panels. Very old hand knit machines.
Oswal Woollen Mills, Plant II 26.10.1981	Garment knitter for export. Blankets made out of wool/acrylic. Knitting machine European made in good condition

TO LOCAL MILLS

Type of problems.	Contact with Facility
Dye fastness. Dye bleeding. Unlevelness. Fabric Speed too slow. Steam Supply. Wrong selection of dyestuff. Shading and matching of colour.	The Facility has given help in laboratory work to provide the samples required. Fastness of dyeing improved to very good standard, Good leveling of dyeing been achieved. Representative attended lecture.
Blankets milling. Dye fastness Knitting tension	Facility staff advising on milling, expert on knitting tension and brushing. Representative attended lecture.
Condensation of steam in fabric. Unlevelness in dyeing. Crease marks in fabric. Locally made and very old dyeing machinery.	Visit with Facility Staff and advice given by the expert in steaming the fabric in different ways to overcome Winch marks and unlevelness. Representative attended lecture.
Dyeing of opt.white, no good bleaching in acrylic. The dyed yarn being dried in the sun.	Advice been given to achieve better results in op.white by change of dye techniques. Facilit Staff attended. Representative attended lecture.
Using wrong type of yarn too loose in knitting tension, Loose weight in milling, garments under weight for export.	Very helpful advice given from Facility Staff in milling, Expert explained in connection of knitting the weight in the fabric for export market. Representative attended lecture.
Scouring, knitting, making up of garments and panels.	Help in finishing. Advice in solvent scouro. Adjust in sizing to milling.
Installation of new three Bowl continuous scouring machine.	Advice given to set up machine. Advice in scouring chlorination. Representative attended lecture.
Stain problem in panels; knitting in general.	Advice been given to overcome the problem by spotting and cover the yarn in special ways.
Yarn doubling and twisting. Irregularity in two fold yarns.	Technical advice given in yarn twisting and doubling to achieve regularity in knitting. Representative attended lecture.

VII. QUALITY CONTROL

Discussions were held with the Research and Development Officer on the most important parameters relevant to quality control and research and development. These included various quality control measures for package dyeing, hank dyeing and fabric dyeing for different fibres.

The procedures adopted while developing a new shade were appraised.

It was pointed out that there was a need to apply a systematic method of attending to complaints from customers, especially when finished fabric was supplied. Quality control parameters for texturized fabrics also featured in the discussion.

Talks were also held on the checks and remedial measures for identifying package dyeing faults; ways and means to reduce pilling were also discussed.

Testing methods of SR treated fabrics and garments, including the degree of washability are described in annex VI.

VIII. OTHER ACTIVITIES

During the preparation of this report a colour range of approximately 12 shades was prepared in acrylic spun-fibre 1/40 package dyeing for marketing purposes.

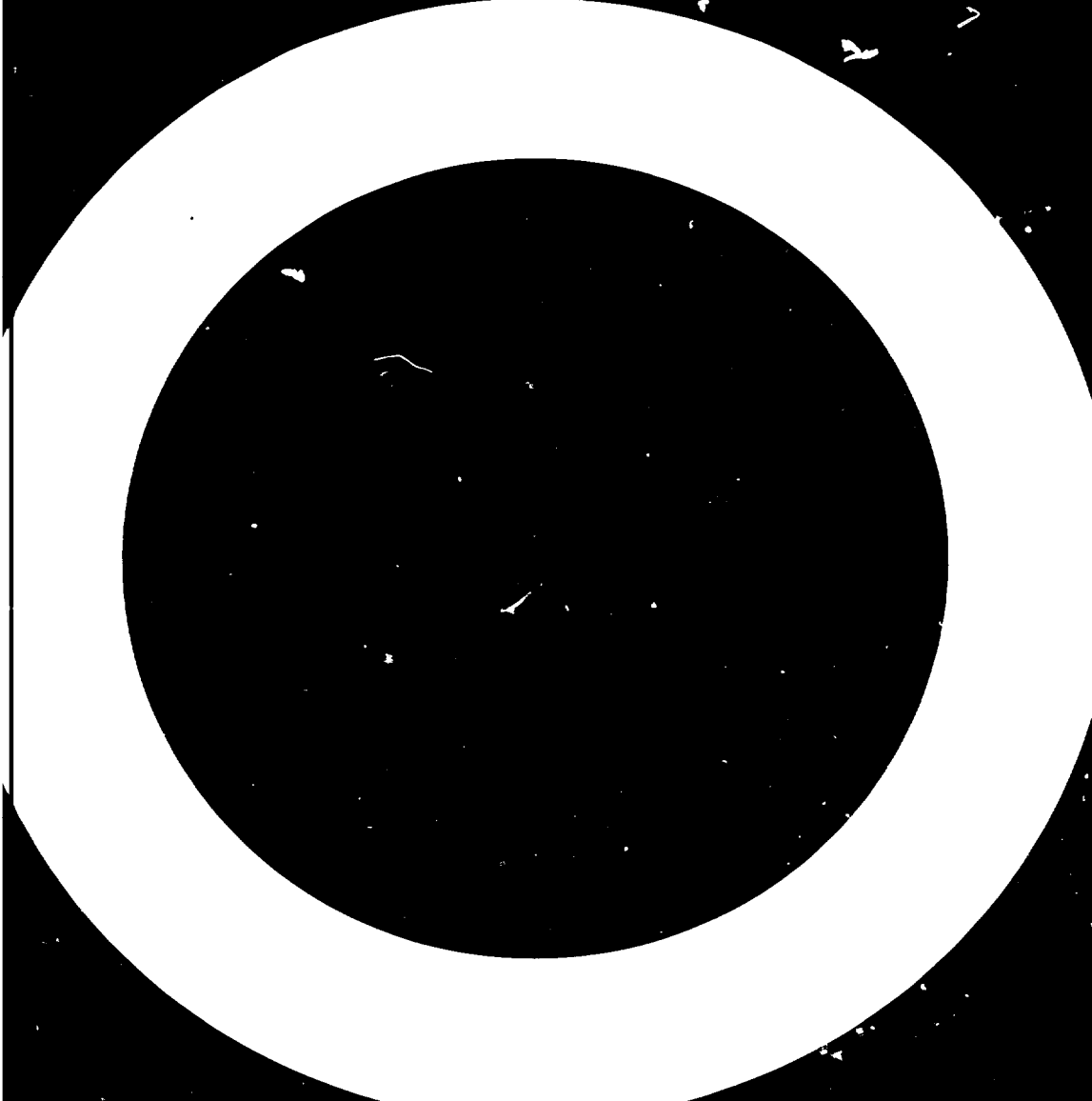
The expert was confident that there would be no further problems in future trials and in processing when this range was established.

Further discussions on dyeing of different fibres and fabrics were held at the Knitwear Facility; in addition, discussions and tests on brushing of acrylic were carried out both within the Facility and elsewhere. See annexes VII and VIII.

A number of technical books and other literature was donated by the expert to the Knitwear Facility and at the request of the Training Officer, the expert will later send a range of papers on staff training in different subject areas.

Acknowledgements

The expert would like to thank the managing director and staff of the Knitwear Facility for their excellent technical co-operation.



Annex I*

JOB DESCRIPTION

DP/IND/73/021/11-07/31.7.B

Post title: Expert in Textile Dyeing and Finishing (Wet Processing)

Duration: Two months

Date required: February 1981

Duty station: Ludhiana

Purpose of project: To set up a central facility to provide technical services to the knitwear hosiery industry in Punjab

Duties: The expert will work in co-operation with the Punjab Hosiery and Knitwear Development Corporation and is specifically expected to:

1. Give advice on practical production methods in wool dyeing and finishing;
2. Give advice on and demonstrate the correction of faults in shrink-proof treatments and subsequent dyeing;
3. Introduce and demonstrate new, appropriate dyeing and finishing processes for chemical fibre years and knitted products including machine settings for the processing of various materials in the centre;
4. Advise the industry on methods to improve the quality of ready-made knitted garments wtih special reference to the introduction of new techniques and processes and to the improvement of existing procedures in dyeing, finishing and processing of knitwear made from wool and chemical fibres.

The expert will also be expected to prepare a final report, setting out the findings of the mission and recommendations to the Government on further action which might be taken

Qualifications: Qualification in the dyeing of yarn and knitted garments of all fibre types and blends; extensive experience in chemical processing both in solvent and aqueous media, particularly shrink resist and superwash treatments for wool yarn and garments; training knowledge in both dyeing and finishing; fully conversant with quality control and with new technologies in dyeing and finishing; ability to give advice on development work

*The annexes have been reproduced without formal editing.

Language: English

Background information: In one year, the country's woollen hosiery knitwear industry produces goods valued at approximately US$ 34 million, approximately $US 20 million of which are exported. 95 per cent of this industry is concentrated in Ludhiana, Punjab, a small decentralised sector consisting of nearly 2,000 units which together employ about 38,000 people. Approximately 20 of these units are of medium-scale and together are responsible for some 97 per cent of the country's hosiery exports. The remainder are classified either in the small-scale or the cottage industry sector. At present, the industry almost exclusively uses imported wool, buying yarn from small- and medium-scale spinning units in Ludhiana and Amritsar or importing the raw wool with their own import license and having it commission-combed. In future, however, when the results of the UNDP/FAO Sheep and Wool Improvement Project have been more widely felt, it is hoped to use an increasing proportion of high-grade locally produced wool.

As a first step towards consolidating the present export achievement and providing an adequate basis for expanding exports into hard currency markets, the Government proposes to take steps designed to improve the quality and treatment of yarn and the design, style and finishing of garments. At present winding is done mainly by hand on traditional charkhas. There is no singles yarn clearing and, therefore, the resulting yarn is uneven in quality. The prototype knitting section is equipped with the following machines:

(a) 4-head Intarsia full-fashioned machine with tuck mechanism - 21 gg;

(b) Automatic jacquard flat knitting machine - JDR-E8, interchangeable needle beds, 8 x 12 gg;

(c) Hand flat knitting machine - single system, 120 cm, 12 gg;

A start has been made to modernise the industry and there are at present six full-fashioned machines with V-bed attachments and thirteen power flat machines. To take full advantage of those machines and of future modernisation - and to ensure a high quality end product - it is essential that singles yarn clearing be introduced. Dyeing is presently carried out manually by obsolete methods with the result that colour fastnes and uniformity of dyeing are not of high standard. Reproduction of colour and colour fastness are essential to achieve Woolmark standards and to increase the present exports. Garment finishing operations are carried out manually, dry cleaning is carried out using synthetic turpentine (which leaves a repulsive odour in the garment) and the pressing is done with flat irons which spoil the handle and fullness of the garment. No modern equipment is available for the various types of garment processing (particularly shrink-resistance processing). The general custom in the industry at present

is to contract out winding, dyeing and garment finishing operations to small independent firms which specialise in these processes. Consequently, the industry suffers from lack of uniformity in those fields and it is difficult to handle large orders and maintain satisfactory standards. Finally, the industry does not have qualified designers. Styles are usually adopted from old trade journals or samples collected abroad which, when reproduced, are outdated.

To overcome the difficulties outlined in the foregoing paragraph, the Government proposes to establish a central hosiery knitwear facility in Ludhiana to undertake yarn winding, clearing, dyeing and shrink-resistance treatment, using modern methods, together with the processing and finishing of garments. Moreover, in order to diversify the product range, the facility will eventually include drawing and spinning, double jersey knitting and fabric finishing.

The above is in line with recommendations contained in a report prepared by the International Wool Secretariat in October 1968 and in subsequent reports. In 1974, the Government and the Ministry of Commerce requested UNDP/UNIDO assistance to establish the facility.

CANDIDATES REQUESTED BY 9 JANUARY 1981

Annex II

SPARE PARTS AND CHEMICALS

The following machine is important for finishing of garments, but it is often out of action for a long time because of mechanical faults.

Kannegiesser Model KF 2	
Parts list for	E-System
Indent No.	150-124/5
Pos No.	D 10 Wipping
Contact relay	
Part No.	015.891/5
Address:	Kannegiesser Machinen Fabric, Vlotho/Weser Federal Republic of Germany

Schlafhorst autoconer

The following parts are required:

Model GKN	x 50
Machine No.	13807792 943
Date	31/7/1979
Catalogue No.	GKG 903 - 22
Name of parts	Molyplex FK-43 spray guns
Quantity	2 cans
Catalogue No.	GKG 308 - 548
Name of parts	double tension shoes
Quantity	30

Tension is important for even dyeing results and the absence of tension shoes creates problems

Urgent needs of the dye house:

Optical brightening of acrylic to obtain full optical white. The most suitable brightening agent is Blanckophor A.N.R. This product is chlorite-resistant and gives a brilliant white. It must be imported from Bayer, Federal Republic of Germany. Requirement: 100 kg.

For the finishing department

Drycleaning bags

Material: Polyurethane

Size: 80 cm long x 40 cm wide

Requirement: 24

Bowe solvent machine:

Solenoid for process card

Part no. will be given later.

Annex III

DETAILS AND INSTRUCTION OF MILLING AND CHLORINATION

The milling of wool garments in perchloroethylene to obtain lambswool, cashmere and Shetland type finishes is now widely used. Milling is the production of a change in the surface appearance of wool fabrics by the combined action of moisture, temperature and mechanical treatment. The effects required are partial shrinkage of the fabric and a partial concealment of the woven or knitted structure.

Milling is traditionally an aqueous process, the soft, lofty finish being achieved by mechanical action on the water-swollen fibre. Although solvents such as perchloroethylene do not swell the wool fibre and do not dissolve water appreciably, water can be easily emulsified in the solvent by the spinning or knitting oils in the garment, by dry-cleaning soaps, or by specially developed solvent-milling aids. The water is introduced into the system either by the injection of live steam or by the prior emulsification of a known quantity of water with a solvent emulsifying agent. The necessary mechanical action is provided by tumbling the garments in the cage of the solvent machine. A large number of machines is available from various manufacturers and their characteristics and operating principles have been discussed elsewhere.

This paper reviews existing procedures for milling wool garments in solvent and discuss variables important in achieving the required uniform finish.

1. Solvent Milling Methods

Although it has been known for many years that wool garments can felt during dry-cleaning if excess water is present, the controlled felting or milling of wool garments in organic solvent containing water and surfactants was not used commercially until the early 1960s. Only a few publications are available on the felting of wool in solvent water mixtures, the main information being confined to the patent literature.

Solvent milling is the subject of a number of patents granted to machinery manufacturers, the rights to the process generally being given free to purchasers of the machine.

The solvent milling patents of Bohler and Weber describe methods of treating wool-containing fabrics, in which water (5-20% owf) is dispersed in a dry-cleaning solvent in the presence of 0.1-10% of a surfactant. The quantity of surfactant added is sufficient to stabilize the water dispersion but less than that required to solubilize it. The required milling effect is obtained by tumbling the fabric or garments in the dispersion for 5-20 min. at room temperature. Extensive information on process variables is available on the machine manufacturers' literature.

Brown and Green Ltd., U.K., the manufacturers of Bentley solvent finishing machines have covered the use of 5% water on the goods weight and 2% emulsifier on the water weight, the degree of milling being controlled not by the content of water but by the temperature of the milling liquor. The liquor is circulated through a closed-loop system containing a heat exchanger and the required temperature (up to 87°C - the azeotropic boiling point of perchloroethylene and water) is controlled by a thermostate. A procedure recommended for milling fine wools is to heat the solvent to 55-70°C during the addition of 5% water and 2% emulsifier and agitate at the chosen temperature for 7 min.

Neil and Spencer, U.K., have been granted a patent for milling wool textiles in solvent where the amount of wager in the solvent in the presence of 0.5-5.0% surfactant by volume of the organic solvent is such that the solvent relative humidity of the final mixture lies between 75 and 99.9%. Solvent relative humidity is defined as the relative humidity with respect to water, of air saturated with vapour above the mixture, at the same temperature as the mixture. In this process, there is more surfactant than water in the liquid and the water is in solution and not present as an emulsion of suspension. As with all other processes, the handle of the treated material can be varied by suitable choice of surfactant. The treatment bath is maintained between 26 and 33°C and the milling effect is obtained by varying the time of mechanical action.

A different method of introducing water into the solvent was developed by the Cherry Tree Machine Co. Here, live steam is injected into the cage and the condensed water is emulsified by the knitting oils on the garments before the solvent is introduced.

The method is claimed to be uniform by distributing moisture throughout the load before the garments are subjected to mechanical action in the presence of the solvent.

Excluding the Cherry Tree method, the general sequence of operations in solvent milling is:

i) Prepare milling bath;
ii) Scour garments in clean solvent;
iii) Return scour solvent to tank and/or still;
iv) Extract at high speed for 3-4 min. and return solvent to tank and/or still;
v) Introduce milling solution from tank;
vi) Introduce water and milling aid through addition-box;
vii) Tumble for predetermined time with circulation of liquor;
viii) Extract at high speed for 3-4 min. and return milling solution to tank;
ix) Tumble garments for 3-5 min. (for Shetland or lambswool);
x) Dry off perchloroethylene;
xi) Deodorise for 3-5 min.

2. Controlling Factors in Solvent Milling

The milling effects and its reproducibility from batch to batch are basically determined by:

a) Garment construction, wool and yarn quality, chemical treatment and colour;
b) Concentration of water in solvent;
c) Auxiliary type and concentration;
d) Temperature of solvent;
e) Severity and time of mechanical action.

By controlling these factors, reproducing results ranging from elimination of relaxation shrinkage through a number of carefully chosen processes, and accurate recording of characteristics of fabrics, every degree of milled finish, even up to a heavily milled effect can be obtained. Control of each of these various factors is discussed below:

a) Garment construction, wool and yarn quality, chemical treatment and colour.

i) Fabric construction. Loosely woven or knitted fabrics mill more readily than tight structures. Further, as the tightness of construction, or cover factor, is reduced, the dimensional change on milling is increased.

ii) Wool quality. For equivalent yarn and fabric structure, finer wools mill more readily than coarser qualities.

iii) Yarn quality. A general rule is that fabrics made from yarn with low twist and greater bulk are easier to mill. Yarns of low twist with a predominance of shorter fibres mill to a soft bulky finish. As with aqueous milling, fabric strength and pilling resistance decrease with increasing severity of milling.

iv) Chemical treatments. Bleached wools are more difficult to mill and require a higher addition of water or a longer milling time than equivalent fabrics made from unbleached wool. Similar results are obtained with chemically or autoclave-set wools.

v) Dyeing. Undyed garments are the most easily milled, the severity of milling required is increasing with depth of dyeing. Most dark colours, and in particular blacks, especially chrome blacks, require the use of considerably more water, a higher temperature, or longer mechanical action depending on the milling method used. As in aqueous milling, a garment style in a range of colours will usually require sorting into two or three colour groups to achieve uniformity of the milled finish.

It is clear from these considerations that accurate records of the detail of each fabric or garment are necessary as a guide to choosing the milling conditions required. For knitted garments, for example, the records should include machine type and gauge, knit structure, cover factor, fabric or garment dimensions and yarn course, count, twist, quality and colour.

b) Water concentration

The amount of water in the solvent, expressed as a percentage of the weight of the garments being milled, is a principal guide to the extent of milling and forms the basis of the Bohler and Weber patents. Below 10% water addition, only relaxation or consolidation effects are observed. Actual milling commences at approximately 10% water and is generally carried out in the range 12-18%. A general guide to the effect of water concentration can be seen in the table below:

Relaxation and consolidation	5-10%
Mild milling effects	10-12%
Moderate milling effects	12-16%
Heavy milling effects	16-20%

These levels can only serve as a guide and the water addition for each garment type must be determined in preliminary tests.

c) Auxiliary concentrations and type

Milling aids are used to emulsify the water evenly and rapidly in the solvent. Dry-cleaning detergents, which are intended to prevent redeposition of water-soluble soils in the garments undergoing cleaning generally are unsuitable as milling aids. Milling auxiliaries have been designed to form fine stable emulsions yet have a minimal affinity for the added water. This is important to enable the wool material to take up the water rapidly. Such auxiliaries are available from a large number of companies and should be selected on their distillation properties, especially absence of foaming and volatile components, and their softening effect on the garment. Although milling auxiliaries with softening properties are generally cationic, they are only sightly substantive to the wool under normal milling conditions. The softening effect depends largely on the concentration remaining on the garments after extracting or draining away the milling solution. This can be determined from the following equation:

$$W = g/l \times PU \times 6.17 \times 10^{-4}$$

where W is the percent of auxiliary remaining on the garments, g/l is the auxiliary concentration, PU is the weight pick-up of solvent in percent, and 6.17 corrects for the specific gravity of the perchloroethylene.

The auxiliary concentration is generally within the range of 10-20 g/l (10-20 lb/100 gal.). During the processing of each batch, further milling aid and water are added to compensate for the quantity taken out on the garments on the previous load. The proportion of solvent retained by the garments after scouring and for the proportion of the milling solvent distilled (if any).

Most auxiliaries can affect subsequent shrink-resist treatments in solvent. Therefore, if such a treatment is required, these agents should be removed from the garments by scouring in clean solvent. A combined milling and shrink resist treatment, however, has been described. In this process a polythiol resin, and amine curing agent, care would have to be exercised to prevent loss of shrink-resistance through premature polymerisation in the bath and extensive build up of deposits through polymerisation of polymer on the walls of the machine.

d) Solvent temperatures

Within the range 20-30°C, the milling effect is not greatly dependent on temperature. Above 30°C the milling effect intensifies and the probability of dye bleeding increases. The solvent temperature depends on the frequency of use of the machine, the ambient temperature and the efficiency of the water coolers used. In Australia, equilibrium operating temperatures of 30-35°C are generally found. Solvent-cooling facilities become important during long production runs in the summer months and additional cooling coils have been fitted to the solvent tanks of some machines. Refrigeration may have to be considered in some localities.

When using room-temperature milling processes occasionally it is found that adequate milling, especially on black dyed garments, cannot be achieved. In such cases the desired effect can be obtained by milling at a higher temperature. This can be achieved by pre-heating the cage (by switching on the fan and heater) and then introducing the milling solution or fitting a steam jacket on a solvent-circulation line. The jacket may be designed so that it may also be used for cooling. Overnight, the solvent temperature can fall to well below 20°C and the solvent may need to be warmed for the first batch. Operating solvent machines within a narrow temperature range, preferably 20–30°C, is good practice not only for milling but also because the solvent pick-up or retention (important in additive processes such as softening and shrink-resisting) is also strongly temperature dependent.

e) Mechanical action

The mechanical action necessary for milling is governed by the rotation of the cage, the level of solvent in the cage, and the weight of goods in the machine.

i) Cage loading. The limits for uniform milling (within and between batches) are approximately 50–70% of the rated machine capacity and, for optimum reproducibility of finish, batch sizes should not vary by 2cc. With some machines the capacity may be overstated and the load size may have to be reduced appropriately. The 100% capacity of the machine, which should only be used for dry-cleaning or scouring, is determined at 50–52cc. per cubic metre of cage volume.

ii) Cage rotation. Cage reversal reduces the mechanical action and hence the milling effect, but it is necessary in the milling of piece goods and sleeved garments to reduce tangling. Up to 30% extra time may be required to produce satisfactory milling. The degree of milling is directly related to the time of agitation and so automatic control of the process is essential.

iii) Solvent level. High levels of solvent cushion the garments and reduce the milling effect. Maximum milling is achieved when fully saturated garments are tumbled with a minimum of solvent in cage. In machines where solvent-level control devices are not available, the solvent level can be controlled by metering in the required amount of the pumping system allowing solvent to enter for a predetermined time.

iv) Drying. During the milling process the wool fibres absorb most of the water in the milling solution. During drying, therefore, milling will continue, though at a reduced level. The greater the absorbed water and retained perchloroethylene content of the garments at the commencement of drying, the greater is the after-milling effect. It is important therefore to subject the garments to a constant extraction before commencement of drying. At low drying temperatures the drying time is longer and the after-milling effect greater. Air-outlet drying temperatures of 70-80°C are usual. After drying, the garments are deodorised for 3-5 min. to remove final traces of solvent.

By varying the nature of the mechanical action through different levels of solvent, tumble time, and machine loading, effect ranging from light surface milling (e.g. for angora or cashmere-containing garments) to dense surface milling (e.g. for lambswool or Shetland type articles) can be obtained. Long-pile, light surface milling effects are more intense when the machine is fully loaded (70% of rated capacity). A medium to high level of solvent is used (5-6 litres) and the solvent is continuously circulated through the base of the machine and back into the top of the tumbling for the required period with the level of milling solution and tumbling garments. Lambswool and Shetland effects are achieved by saturating the garments with milling solution and tumbling for the required period with the level of milling solution below or only slightly above the base of the cage. In some cases, tumbling the garments for 3-5 min. after extraction of the milling solution and before drying is needed to produce the required loftiness of the finish.

3. Further Considerations

i) Dosing rates. Because scouring usually precedes milling, the garments carry over a certain amount of solvent, usually 20-25%, depending on the degree of extraction. This solvent dilutes the milling solution and must be allowed for during the addition of milling aid and water. Correction must also be made for the milling aid removed on the finished garments. As a rule, 1 gm. per litre of milling aid per litre of solvent is added with the required weight of water (12-16%) on the weight of goods to the standing milling bath. For consistent milling it is important that the milling aid and water are precisely measured (plastic 2-litre measuring cylinders are ideal) and thoroughly mixed before addition through, preferably, a programmed addition-box. The addition should be completed within the first minute of milling to allow uniform dispersion of the water in the solvent.

ii) Reproducibility of milling. The common causes of irreproducibility in milling are variations in the yarn quality or variations in construction of the knitted material.

Other causes include:

a) Change in atmospheric humidity conditions. On days of high humidity it is advisable to closely watch the treated garments and lower the water input by 0-5-1.0% if necessary.

b) Increase in solvent temperature, particularly in hot weather. It is advisable to place thermometers in the wash tanks and to make regular checks on the temperature of the cooling water.

c) Over-loading the machine. When this happens the garments do not mill evenly all over. With bulky garments the load size may have to be reduced to less than 70% of rated capacity. Uneven milling may also occur if the work is loaded into the machine in tight bundles. It is advisable to load the garments singly or in small lots. Garments or pieces with pronounced curling tendencies may have under-milled areas in the curled region.

[illegible] ation of drying through build up of deposits of fibre in the air-duct systems. The results in over-milli[illegible], and the cage walls, air ducts, and air-filter bag should be regularly inspected and cleaned. Increase in drying time can also result from high water-coolant temperatures in the condenser of restrictions on water flow through blockages in the coolant pipes.

iii) Distillation. Distillation of solvent containing large quantities of water may lead to boiling over or bumping. The steam valve should be turned on slowly and the position at which the still boils gently and uniformly should be noted on the valve adding a broken house brick to the still helps to prevent bumping. Special antifoam agents for solvents are available [e.g. Fumexol SL-FX (Ciba-Geigy)] and are particularly effective in reducing foam with troublesome liquors. Aqueous antifoam agents should not be used as they increase the foaming of chlorinated hydrocarbons during distillation.

iv) Maintenance. Milling of garments and pieces results in relatively high accumulation of lint within the machine. The button trap should be checked and emptied if necessary after every load. The air-filter bag or screen should also be checked and cleaned regularly. Passing milling solutions through powder filters may lead to rapid increases in filter pressure and hence reduced circulation rate. If moisture-curing polymers are also applied from the solvent machine, particular care should be exercised in keeping the cage walls and ducts free of lint and polymer. Polymer-fibre deposits can build up rapidly and during extraction, parts of garments protruding through the cage perforations can rub against the deposits to produce severely abraded or stained areas. Where the build-up of deposits is severe, rubbing of the cage against them has been known to generate sufficient heat to burn garments lying adjacent to the cage wall.

Annex IV

WOOLMARK SPECIFICATION FOR DIMENSIONAL STABILITY OF KNITWEAR

Woolmark specification 8

1. General description

This specification is written in terms of:

(a) Initial acceptance testing carried out by the licensor or his agent;

(b) Subsequent routine in-plant control testing carried out by the license or his agent.

The procedures and tolerances are arranged so as to reduce the difficulties caused by variation in test severity within and between test stations.

2. Testing

Testing may be carried out by the dynamic method described in Woolmark Specification 8, Schedule 1.

3. Acceptance testing

Initially compliance with the specification is determined by means of the following procedure:

(a) Test one sample and take action according to the following:

If results are	Length dimensional change	Action
Less than	5%	Accept
Between	5 - 12%	Test a further sample
More than	12%	Reject

(b) If a second test is indicated test a further sample, calculate the mean of the two test results and accept if the mean value is less than:

Length dimensional change
8.5%

4. Subsequent in-plant control testing

Continued compliance with the specification is indicated if the following limit is not exceeded at a rate greater than five times per 100 tests (single sample tests):

Length dimensional change
8.5%

Note: The following is the mean value that should ensure that the in-plant control limit (4) is met:

Length dimensional change
5%

Appendix No. 1 to specification 8
External test limits

In carrying out external policing of this specification, it is important that action be taken only if the test results indicate that the deficiency is greater than can be ascribed to test variance along. The following limit would only be exceeded 5% of the time if the goods are on the specified limit (single sample tests).

Length dimensional change
9%

Woolmark specification 8, Schedule 1

Dynamic relaxation shrinkage test

(Note: Although the test measures dimensional change the term shrinkage is used hereafter because it is much the most likely dimensional change, and its use avoids unnecessarily verbose instructions)

1. General description

The test method measures the dimensional changes that occur on wetting a garment of fabric and that result from strains imposed on the article during manufacture. By employing a small amount of mechanical action the test causes such relaxation to occur rapidly.

Samples after marking and measuring are allowed to relax by static soaking in a suitable liquor followed by a brief agitation to complete the relaxation otherwise hindered by frictional constraints. After re-measuring the samples the relaxation shrinkage is calculated from the difference between the original and relaxed measurements.

2. Apparatus and materials

2.1 Cubex International Shrinkage Testing Apparatus

Inquiries concerning this apparatus should be directed to:

The Technical Manager
New Zealand Wool Board
P.O. Box 3248
WELLINGTON

2.2 Make weights

25 gms, squares of double cotton interlock fabric having a loop length of 2.9 mm. and made from 12 x 1 TEX cotton yarn. The squares must have rounded corners, and have no loose ends or possibility of unravelling. The makeweights must be adjusted to pH 7 prior to use.

2.3 Phosphate pH 7 Buffer

A solution containing 4.5 g NaH_2PO_4(anhydrous) plus 8.0 g Na_2HPO_4(anhydrous) per litre, this solution being designated a 1.25% phosphate pH7 buffer solution. Distilled water is not essential but hard water (say greater than 100 ppm $CaCO_3$) should be avoided.

2.4 Non-ionic Detergent

Surfactant of the Ethylene Oxide Alkyl Pheonl condensate type.

2.5 Linear scale (ruler) accurately graduated in cm. and mm.

2.6 Conditioning Apparatus

Means shall be provided for producing atmospheres for conditioning as specified in paragraph 5.1

3. Test samples

3.1 Garments

The test sample may be:

(a) Entire garment minus sleeves
(b) Entire garment with sleeves tucked inside
(c) Pieces cut from a portion of the garment and prepared as in 3.2

Type (a) sample is preferred.

3.2 Fabrics

Double thickness samples must be used being approximately 3C cm. wide and 40 cm. long (not less than 23 cm. x 30 cm.), and should in all cases have a width to length ration of approximately 3 : 4. The double thickness amples should be prepared by sewing the free edges with dimensionally stable thread. If after so doing, there remains the possibility of unravelling during washing, the samples should be turned inside-out by leaving about 4 cm. unsewn in one corner.

4. Marking of samples

4.1 Indelible ink or small knots of cotton thread may be used, making each mark as small as possible.

4.2 In the case of fabric and fabric pieces cut from garments, the marks should be placed not less than 2.5 cm. from the edges of the samples.

4.3 In the case of garments, the marks should be placed not less than 5 cm. from welts or seams. If experience in a particular case shows that welts cause unmanageable distortion of the sample, these welts should be removed prior to the test.

4.4 The marks should allow three separate measurements in each direction as in Figure 1. Indicate the length direction by means of a suitable mark.

4.5 In the case of socks, stockings and gloves, marks are placed to permit two and if possible three length measurements.

5. Measuring of samples

5.1 All measurements shall be taken on samples which have been exposed to a standard atmosphere of 65 + 2% relative humidity and 20 + 2°C for a sufficient time to establish equilibrium. This time should be not less than four hours. Conditioning shall take place starting with the samples on the dry side.

5.2 Measurements shall be taken:

(a) Initially (Original measurement O.M.)
(b) After relaxation (Relaxed measurement R.M.)

5.3 In all cases samples shall be laid flat, wrinkles gently removed without stretching the measurements made from centre to centre of the marks.

5.4 Calculate the mean of the three measurements in each direction and use these mean figures for subsequent shrinkage calculations.

6. Relaxation

6.1 After noting the original measurements relax the samples by treating them in the Cubex International Shrinkage Testing Apparatus under the following conditions:

Liquor - 25 litres 1.25% pH7 Buffer solution containing 0.05% Nonionic Detergent.

Load – 1000 g made up of test samples plus makeweights, not more than half the load being test samples. (If one sample weighs more than 500 g the limitation regarding the proportion of test samples does not apply).

Temperature – 40°C

Time – 15 minutes static soak followed by five minutes tumbling.

6.2 Remove the test samples from the Cubex International Shrinkage Testing Apparatus, and rinse by static soaking in three successive baths of clean water at 40°C. Transfer the samples from bath to bath by giving one gentle hand squeeze to express excess liquor.

6.3 Hydroextract the samples using a laboratory or domestic spin drying apparatus. Place the samples in the cage in such a way as to avoid stretching during spinning. Continue the hydro-extraction until no further water is lost.

6.4 Dry the samples by laying them flat on a surface of low frictional characteristics, e.g. smooth plastic or metal. Elevated temperatures may be used if desired, but should not exceed 80°C. If air flow is employed the air velocity should not be so high as to cause agitation of the samples during drying.

6.5 Measure the samples as indicated in Section 5.

7. Calculations

7.1 Linear shrinkages are determined thus:

$$\% \text{ Relaxation Shrinkage} = \frac{\text{O.M.} - \text{R.M.} \times 100}{\text{O.M.}}$$

7.2 Area shrinkages are determined thus:

$$\% \text{ Area Shrinkage} = \% \text{ Width Shrinkage} + \% \text{ Length Shrinkage} - \frac{\% \text{ Width} \times \% \text{ Length}}{100}$$

in the case of small shrinkages (e.g. less than 10% area) the factor:

$$\frac{\% \text{ Width} \times \% \text{ Length}}{100}$$

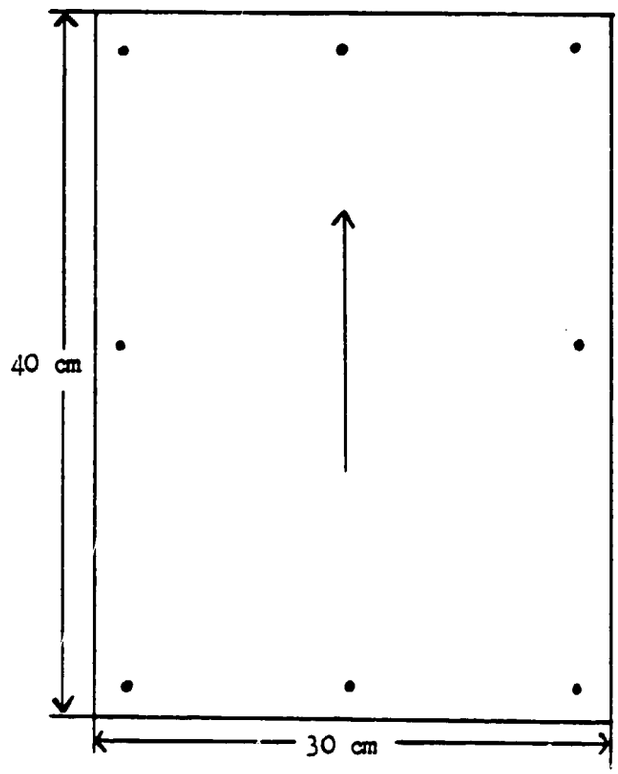
is small and may be ignored.

8. Report

8.1 Report the three shrinkage figures (to nearest 0.1%)

Relaxation : width, length, area

quoting the test procedure (Woolmark Specification 8, Schedule 1). Indicate whether the figures refer to shrinkage or extension by stating the sign convention used.



Annex V

FINISHING TECHNIQUES FOR WOOL, WOOL BLENDS IN GARMENT AND PIECE FORM

Superwash treatment of different methods, clorination of wool and milling.

Finishing techniques of wool and their blends, has a very large range.

Wool as a natural fibre has its own characteristics.

Moisture content

Wool absorbs water from a moist atmosphere and looses it to a dry one. This character is very important as it considerably affects the knitting.

Panels knitted for making up garments will show the difference in finishing, if the knitter does not allow more width in the knitting.

The most common way is to knit one size up.

Wool is completely resistant to all organic acids and it is less resistant to alkalies. Therefore any scouring in winches or paddle machine, have to be of nonionic character and ammonia.

To overcome the shrinking and felting problem a solvent scour is recommended.

A solvent process will make wool fabric very lean therefore a steam pressing is necessary to regain the weight lost.

Other factors in this matter are short fibres, irregularity in the fibre and mix of count.

Fabric made on circular knitting machines are finished on a stenter in continuous process after slitting.

Temperature 80°C with steaming in the relaxation, shrinkage in this way controls stitch construction.

Wool - Acrylic blends

Finishing of wool - acrylic is different as 100% wool; the acrylic gives the wool stability.

Very dirty fabrics can be winch scoured or a solvent scour is recommended.

Open width finishing in a stenter at temperature of 150°C with introduction of steam, circular finishing achieve a good result on a calender or roller steaming machine temperature 140°C with overfeed.

Extreme care has to be given in preventing of creases.

Polyester wool

Polyester wool blends are mainly in 60/40 or 70/30 or 80/20, the less the precentage of wool the more stable is the fabric.

Heat setting condition

These depend on weight and surface condition and must always be adapted accordingly. It is therefore impossible to draw up uniform instruction. Heat setting as a guide for the above blends are 180°C.

Cutting of fabric

Care must be taken to draw or lay the fabric out very carefully and free from tension.

Cutting must be extremely accurate because of the waste, this matter is in general on any fabric.

Polyester with 45% of lambs wool has to be adjusted in fineness and stable length to the polyester fibre used.

So called short tops must not be used.

Clorination of wool

A dylon treatment is patent and the yarn very costly but less problems.

Basolan DC, is a felt resist clorination and as good as a dylon treatment.

The anti-felt finishing of undyed wool (and also dyed wool within limits, is not recommended) as well as all kinds of fibre blends containing wool, either in the form of:

a) Loose stock
b) Tops
c) Knitgoods (garments parts or piece goods)
d) Blankets or upholstery materials.

Machinery required

For tops and card sliver; the usual back washer with unrolling device. At least three bowl squeeze units and drier.

For woven knitgoods

Padder, continuous open width unit and drier (stenter) or two padders.

For circular knitgoods

Winch clorination is very successful.

For example

1) Prescour

Non-ionic detergent	2%
Ammonia	2%

30 min. at 50°C, 2 rinses.

2) Start cold, set PH at 4 - 4.5 with acetic acid, add Basolan DC 4 - 4.5% O.W., slowly run 40 min., raise at 50°C, run 20 min.

3) Add 8 - 10% O.W. of sodium bisulphate (anti-clorination) Run 20 min. 2 rinses. Finish.

4) Same process been used in garment form on a side paddle machine.

Wet finish treatment for 15GG full fashion garment made from Basolan treated tops.

1) Measure garments before wet finish.

2) Fill side paddle until the fabric moves.

3) Add a softener, activate paddle solution through centre channel bath temperature 40°C.

4) Circulate for 20 min., then cool down to 20°C.

5) Remove garments from paddle machine and hydro for 1½ min.

6) After hydroing the garments a soft tumble dry at 40 - 50°C.

Milling

The milling of wool garments in perchloroethylene to obtain lambswool, cashmere and shetland type finishes is now widely used. Milling is the production of a change in the surface appearance of wool fabrics by the combined action of moisture, temperature and mechanical action.

The effect required are a partial shrinkage of the fabric and a partial concealment of the woven or knitted structure.

Milling is traditionally in aqueous process, the soft, lofty finish being achieved by mechanical action on the water-swollen fibre.

Milling effect will get on any wool fibre and their blends.

Milling methods

Although it has been known for many years that wool garments can felt and loose weight during dry-cleaning if excess water is present.

The controlled felting or milling of wool garments in organic solvent containing water and surfactants was not used commercially until the early 1960s. Only a few publications are available on the felting of wool in solvent - water mixture, the main information being confined to the patent literature.

Controlling factors in solvent milling

The milling effect and its reproducibility from batch to batch (has to be controlled) are basically determined by:

- Garment construction, wool and yarn quality, chemical treatment and colour;
- Concentration of water in solvent;
- Auxiliary type and concentration;
- Temperature of solvent;
- Severity and time of mechanical action.

A garment construction, wool and yarn quality and colour:

1) Fabric construction

Loosely woven or knitted fabric mill more readily than tight structures.

2) Wool quality

For equivalent yarn and fabric structure, finer wool mill more readily than coarser qualities.

3) Yarn quality

A general rule is that fabrics made from yarn with low twist and greater bulk are easier to mill.
Yarns of low twist with a predominance of shorter fibres mill to a soft bulky finish.

4) Chemical treatment

Bleached wool are more difficult to mill and require a higher addition of water or a longer milling time than equivalent fabrics made from unbleached wool.

By carefully following these procedures most of the problems will not occur. In any case if problems arise, the nature of the problem is to be found in one of the aspects mentioned above. For example, a change of yarn quality or yarn twist might show variation in the dimension of the garment.

Machine washability and superwash treatment of woollen garments by applying resin with polymer

This treatment has three different forms of application:

1) Application by a solvent spray system;
2) Exhaust system of resin and polymer by the "Drip-feed System" on garments and panels;
3) Padding with heat fixation and curring for continuous circular fabric.

Fabric to be treated for application under article 1 and 2 have to be free of any needle oil and other dirt.

During mill visits it was noticed that even after solvent scouring the fabric was not clean and still showed oil lines, chalk markings and other stains.

The solvent process

1) Scour fabric first low speed for 3 min.
30 sec. Hydroextration, intermediate speed.
Spray for 8-12 min.
with 3% weight of garment synthappret LKF 0.3% catalyst
Tumble 5 min.
Drying 30 min. Pick up 100%
Damper cooling to 40°C
Take out and lay the fabric flat in order to avoid further creasing.
The full anti shrink effect is obtained after the goods have been stored for about five days.

Shape setting (pressing) should be done immediately.
Addition after-treatment for further improvement of the fabric should not be done until after the fifth day.

2) Exhaust application

After dry-cleaning, the garments are milled at 40°C and a pH of about 9.5 by applying a non-ionic detergent (1% o.w.g.) and 0.5 g/l soda ash (liquor to goods ratio 30:1)
Rinse twice.
After adjusting pH to about 7.5 (acetic acid) and the temperature 30°C, the mixture of the pre-diluted BAP and DLN is poured or drip fed (within 2 mins.) into the centre of a paddle machine. Allow for distribution (liquor to goods 30:1) 5 min.
6 g/l Mg. Cl_2. $6H_2O$ (pre diluted) are then drip fed within 10 mins. into the centre of paddle machine.

		Total
(pH will then be about 7-7.3)	10 min.	15 min.
Temperature is raised from 30°C to 50°C within 20 minutes (1°C per minute)	20 min.	35 min.
The bath is kept at 50°C for 10 minutes to complete exhaustion (to approx. 90%)	10 min.	45 min.
Ammonia (d = + 0.88) is added (pre-diluted) to increase the pH to 9-0.2 (about 0.75 ml/l)and the bath kept at 50°C for 15 mins.	15 min.	60 min.

		Total
Acetic acid (80%) is added (pre-diluted) to lower the pH to 5-6 (about 0.85 - 0.9 ml/l), and if required a softener (pre-diluted) is drip-fed within 2-3 minutes and exhausted onto the garments.	10 min.	70 min.
Cool down by partially dropping the bath and adding cold water.	5 min.	75 min.

Shetland garments knitted from pre-dyed yarn require 2.5%.

In case of lamb woollen garments may be necessary to increase the combination to 3%

The padding process

The padding process on continuous circular fabric by heat curring

Scour first in the winch with non-ionic detergent 2%

Ammonia 1%

30 min. at 60°

2 rinses

Hydro extracted

Splited fabric and lapp out.

Padding with synthappret B.A.P.

Impranil DLN dispersion and sodium bicarbonate

Padd mangel pick up of 70%

Heat curring on the stenter at 160°C fabric speed

12 mtr/min. and final decadizing through a steam cylinder.

Recommended machinery for the described processes are:

- stenter
- padder
- calender up dryer
- brushing
- decadizer

Annex VI

QUALITY TESTING AND WASHABILITY ON S.R. TREATED FABRICS AND GARMENTS

1. Purpose and Scope

1.1 This test is intended as a small scale, accelerated laboratory test to predict the fastness of the colour of wool textiles to repeated washing.

2. Principle

2.1 A specimen of the textile in contact with specified undyed adjacent clothes is agitated in a washing solution, rinsed and dried. The change in colour of the specimen and the staining of the undyed clothes are assessed with standard grey scales.

3. Apparatus and Reagents

3.1 Mechanical Washing Device

This device should comprise closed, cylindrical washing containers attached to a rotor, rotation of which brings the necessary agitation during washing. Suitable devices available are described in 7.2.

3.2 Washing Powder

Softy or any other washing detergent.

3.3 Washing Solution

Containing 5 gm washing powder/litre of distilled water.

3.4 Undyed shrink resist treatment knitted wool fabric (see 7.3) for each test, on piece 100 x 40 mm is required for assessing. Wash one piece of the undyed adjacent cloth in a separate bath according to the procedure described in 5.1 - 5.3.

3.5 Undyed bleached woven cotton fabric (see 7.3).
For each test, one piece 100 x 40 mm is required.
For assessing, wash one piece of the undyed adjacent cloth in a separate bath according to the procedure described in 5.1 - 5.3.

3.6 Grey scales for assessing change in colour and staining (see 7.3).

4. Specimen

4.1 If the textile to be tested is fabric, take a specimen 100 x 40 mm and place one piece of undyed wool fabric (see 3.4) above one half of the specimen and one piece of cotton fabric (see 3.5) below the specimen. Sew round the four sides to form a composite specimen.

4.2 If the textile to be tested is yarn, then knit it into a fabric and treat as 4.1 or form a layer of parallel lengths of it between the adjacent fabrics. Sew around the four sides to hold the yarn in place and form a composite specimen.

4.3 If the textile to be tested is loose fibre, comb and compress an amount weighing approximately the same as the combined weight of the undyed clothes (see 3.4 and 3.5) into a sheet 100 x 40 mm. Place the sheet between the adjacent fabrics and sew around all four sides to form a composite specimen.

5. Procedure

5.1 Place the composite specimen in the container of the washing device (see 3.1) and add the necessary amount of washing solution (see 3.3), previously heated to 50 ± 2°C, to give a liquor ratio of 50:1.

5.2 Treat the composite specimen at 50 ± 2°C for 45 minutes.

5.3 Rinse the composite specimen twice in cold, distilled water and then in cold, running, tap water for 10 minutes, hydro-extract it (see 7.4). Remove the stitching along two long sides and one short side of the sample, open out the composite specimen and dry in air at room temperature with the three parts in contact only at one line of stitching between each adjacent and the specimen (see 7.5).

5.4 Assess with the Grey Scales (see 7.1) the change in colour of the uncovered portion of the specimen and the staining of the undyed clothes.

5.5 If, after assessing, the change of shade falls below the standard by half a point according to the specification and the staining of adjacent fabrics meets the specification, then re-test as follows:

5.6 Sew round the three sides from where the stitching was removed after the first wash;

5.7 Repeat procedures 5.1 and 5.2 two more times;

5.8 After the third and final wash repeat procedure 5.3 and 5.4.

6. Report

6.1 Report the numerical rating for the change in colour of the test specimen and for the staining of the undyed adjacent clothes after the first and, as appropriate, the third wash. Report that the samples were tested according to the required New Zealand Board standard.

7. Notes

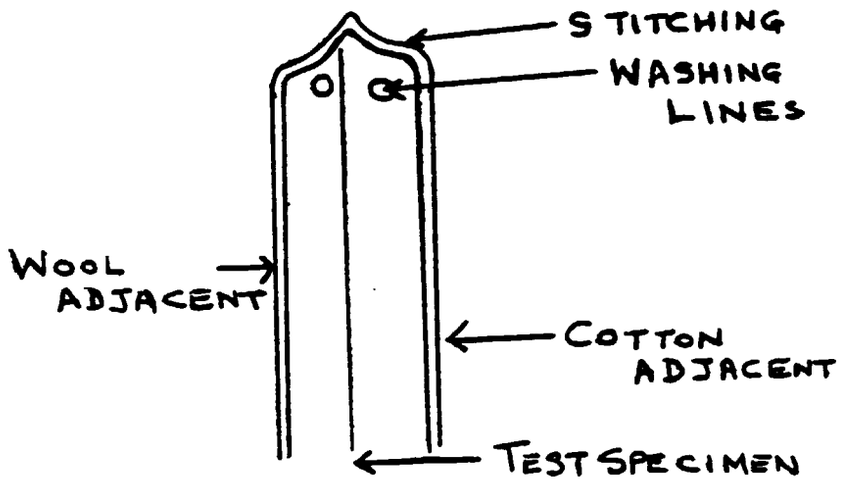
7.1 Assessment of change in colour is carried out by visually comparing the contrast between washed and unwashed specimens with the contrast represented by five pairs of neutral colour chips in the Standard Grey Scale for Assessing Change in Colour specified in I.S.O. Recommendation R.105, part 2 (see 7.3). Assessment is based on the magnitude of the visual contrast irrespective of whether thereby change in depth, hue, brightness or any combination of these.

Assessment of degree of staining is carried out by visually comparing the contrast between the side of the adjacent undyed cloth with the contrasts indicated by the Standard Grey Scale for Assessing Staining specified in I.S.O. Recommendation R.105, part 3.

In assessing colour fastness a piece of the original material and the tested specimen (for change in colour) or the undyed (see 3.4 and 3.5) and stained clothes (for degree of staining) are arranged side by side in the same plane and oriented in the same direction. The surrounding field is a uniform grey, slightly darker than the darkest member of the Grey Scale for Assessing Change in Colour. The surfaces to be compared are illuminated by north sky light in the Northern Hemisphere, south sky light in the Southern Hemisphere, or equivalent source with illumination 540 lux or more. The light is incident upon the surface at approximately 45°, and the direction of viewing is approximately along the perpendicular to the plane of the surfaces.

7.2 Any domestic spin drier having a spin speed of more than 200 rpm is suitable. Any number of composite specimens may be hydro-extracted at any one time. The time of hydro-extraction should be 30 seconds.

7.3 The composite specimen should be dried in a vertical position by suspending the opened composite specimen over two parallel lines - plastic covered domestic washing line is recommended - as shown below:



7.4 When testing at any industrial stage this test method should be applied with the knowledge of any future processes to which the material may be subjected.

7.5 For example:

1) Lambswool and Shetland yarns in the greasy state should only be tested after being scoured using scouring conditions similar to those used by the particular dyer and finisher;

2) Some dyes are sensitive to acid chlorination and material should only be tested after an appropriate shrink resist process has been applied.

Annex VII

COMMENTS ON S.R. AND PROCESSING METHODS OF DOUBLE KNIT JERSEY

Introduction

Synthappret B.A.P. is the bisulphite adduct of a polyisocyanate. When applied by a padding process in combination with a second polymer. Impramil D.L.N. dispersion is an extremely effective shrink-resist treatment for wool piece goods, both woven and knitted. The use of synthappret B.A.P. in combination with a polyurethane dispersion has proven most successful.

Summary of the processing method

Synthappret B.A.P., in combination with a polymer dispersion and sodium bicarbonate, is applied to scoured woven or knitted fabrics. Single knit scoured, double knit unscoured by a pad-dry process.

The drying temperature is increased above that which would normally be used for drying wool fabrics, so that the polymer is completely cured during the drying operation. The fabric does not have to be washed afterwards to remove residual catalysts, because a complete curing installation is installed.

Using this process, fully machine - washable wool and wool/blend fabrics can be produced which have excellent finish retention through washing.

The smooth drying properties of fabrics are improved by the treatment and flat setting the fabric before or after finishing can give a non-iron effect.

Synthappret B.A.P.

The product is supplied as a yellow, viscous liquid containing approximately 50% active substance. The product is anionic in charter and is soluble in water. Under normal conditions of storage the bulk product is stable for 12 months, but this may be reduced to 6 months under tropical conditions.

Impranil D.L.N. dispersion

Impranil D.L.N. is a 40% solids aqueous dispersions of polyurethanes. The product has a bulk storage life of 6 months and should not be exposed to temperature below 3°C or above 40°C. Drums containing the product should be well sealed, otherwise a plastic film will be formed on the surface which cannot be redispersed in the polymer.

Polymer blending

Optimum performance is achieved by blending the polymers in the ratio of 1 part Synthappret B.A.P. (50% solids) to 1 part Impranil D.L.N. dispersion (40% solids). Blend containing a lower proportion of Synthappret B.A.P. may display reduced shrinkage control.

Fabric preparation

Fabric intended for treatment with Synthappret and Impranil should have been scoured to remove processing oils which might otherwise interfere with the adhesion between the polymer and the wool fibres.

Some knitted fabrics can be treated without prescouring but if inconsistent results are obtained then the interference or spinning or knitting additives must be suspected and an aqueous or solvent scouring procedure should be instituted.

Fabric pH

Fabrics presented for superwash treatment with Synthappret B.A.P. must be greater than pH 5, ideally should be between 6-7. Inconsistent results will be obtained if the fabric pH 4 and 5, and the polymer will not cure if the fabric is more acidic than pH 4 (see under process).

P.A.D. liquor formulation

The concentration of Synthappret B.A.P. and Impranil D.L.N. used in the treatment bath will be determined by the structure of the fabric to the treated and the level of washability required. Suggested treatment levels and pad liquor formulation for different types of fabric are given below. These treatment levels should be adequate to achieve consistently the "superwash" level of washability but the machine washability specification may be met by the application of lower amounts of polymer. Similarly the amount of polymer required to stabilise wool-blend fabrics will be lower than for all-wool fabrics.

P.A.D. solution for worsted suitings

Total resinsolids owf 1-2%

Bath formulation 70% pick up after padding

15 - 30 gm/l	Synthappret B.A.P.
15 - 30 gm/l	Impranil D.L.N.
3 - 4 gm/l	Sodium bicarbonate
10 - 15 gm/l	Persoftal S.W.A.

Single jersey fabric

21 gm/l	Synthappret B.A.P.
27 gm/l	Impranil D.L.N.
10 gm/l	Sodium metha bisulphat
3 - 5 gm/l	Sodium bicarbonate

Double knit interlock and jacquard fabric

35 gm/l	Synthappret B.A.P.
35 gm/l	Impranil D.L.N.
6 gm/l	Sodium bicarbonate
20 - 30 gm/l	Persoftal S.W.A.

Notes

1. All padding liquor should contain 3-5 gm/l sodium bicarbonate, which catalysis the curing of the polymer.
2. Synthappret B.A.P., in common with many other shrink resist treatments causes a slight change of shade (brightness).
3. To improve whiteness in treated fabrics, optical brightener for example Blankophor D.C.R. liquid 2 gm/l may be added to the pad liquor.
4. Cationic products, ammonia and amines can destroy the shrinkage control properties of resin and consequently should not be added to padding liquor.
5. Padding liquor should be prepared by dissolving all the products and added to the holding tank in order as you read under bath formulation.

Work and treatment process

1. Single knit jersey eccru

   Scour with non ionic detergent 2% ofw. Ammonia 1% ofw.
   30 min. at 40-50°C. 2 cold rinses.

2. Dyeing

   Use selected dyes as acids or premetal complex dyes.
   Reactive dyes are also being used. Wet fastness not under 3 min.

3. Set bath with auxiliaries. Raise to 40. Add dye. Run 10 min. Raise slowly to the boil. Run 60 min. Sample. 2 Rinses.
4. Hydroextracted.
5. Cutting.
6. Lapping.
7. Drying in relaxed form overfeed as required
   12-15 met per min. at 160°C.
8. Padding

Single knit yarn dyed fabric

Follow as 1.4 - 8

A presolvent scour is also recommended.

Heat curing in stenter

Primarily the fabric must be overdried. Speed 9-12 metre per min. With maximum overfeed. A drying temperature of maximum 160°C is used. The drying condition can be varied either by changing the temperature or by altering the dwell time.

For double kit fabric two runs are required.

Steam curing

Final curing after heat curing. If the drying is not sufficiently effective a semi-decatizing of the fabric for 6 min. with steam and subsequent 7 min. cooling (vacuum) is recommended.

Relaxation shrinkage

The fabric must be dryed at minimum tension to minimize the relaxation shrinkage in the fabric.

A stenter with overfeed facilities is essential for this purpose and fabrics should be dried at their wet width plus 30-50% of the relaxation shrinkage.

Post dyeing

Dyeing the fabric after resin treatment has a pronounced softening effect on the handle of the fabric and the shrink-resist treatment will preserve the surface appearance of delicate fabrics through the dyeing process.

Trouble shooting

The performance of fabrics treated with resin should be checked batch to batch during production runs. The most common causes for the failure of resin treatments to give shrink resistance are:

i) Inadequate scouring of the fabric presented for superwash.

ii) Fabric pH too acid - check that pH of an aqueous extract of the untreated fabric is greater than pH 5.

iii) Incorrect pad liquor formulation. Check record of all calculation, weight and additions made.

iv) Incomplete curing. Check semi-decatizing the fabric.

Use of "superwash" labels

Manufacturers wishing to claim "superwash" performance for treated fabrics must ensure that fabrics meet the appropriate IWS Woolmark standards specification, including tests for washability and colour fastness, and must contact their local IWS branch to ensure "superwash" labels has been met.

These papers have been discussed with the finishing master at Knitwear Facility and trials have been executed in treatment and washability.

Annex VIII

DYEING AND FINISHING OF POLYESTER FABRIC

1. Introduction

The excellent easy care properties of knitted goods in general and jersey articles in particular, made of polyester, can only be achieved by a suitable finishing process.

As with every type of knitted fabric, all finishing processes must be performed under the lowest possible tension to obtain a flexible handle, a uniform stitch structure and the desired full handling character of the goods.

2. Circular knitted piece good, yarn dyed

To facilitate the removal of the centre fold, the dry cloth should be cut open promptly after taken from the machine.

2.2 Scouring

Scouring can be done over the full width or in rope form on the winch or jet machine.
Scour for 20-30 min. at 45-50°C
By adding a non-ionic product
1 - gm/litre detergent
1 - gm/litre soda ash
1 - gm/litre calgon T
2 rinses, last rinse softener acting at the same time as antistatic agent.
Scouring in full width should take place at a temperature of 60-80°C.

2.3 Dehydrating

Squeezing or suction extracting of jersey goods is not advisable.
To avoid lying pleats, drying should immediately follow on the centrifuging process.

2.4 Heat setting

Heat setting is an important finishing process and is performed in the stenter. The contact time of heat is 30 sec. with overfeed.
Setting temperature 160°C - 170°C.

2.5 Dry-clear ng

To remove lubricants and dirt the fabric can be treated in a solvent machine instead of conventional wet scouring. The drum should only be loaded with half to 2/3 of the usual quantity and the drying temperature should be kept at 60°C to ensure the required shrinkage.

3. Piece dyeing on winch

To prevent creasing and to obtain a slight shrinkage it is an absolute must to heat set before dyeing. The finishing process for the piece dyed material is the same as under 2.4.

3.1 Winch dyeing at the boil

The best result is obtained by using higher quantities of carriers.

Setting of dyebath

Set bath 55-60°C

1 gm/litre dispersion agent

2-8 gm/litre carrier, depends depth of shade
Run 10 min. add disolvent

X% of disperse dye
Run 10 min. Heat up 2°C per min. to boil,
Boil 60 min. Sample deep shade run 90 min.
2 rinses for pale shade dehydrating
Medium to dark shade
Reductive clearance with

2% Hydrosulphite and

0.5% Detergent. 2 rinses. Dehydrating

3.2 Irregularities inherent to the material can be better eliminated while dyeing at a temperature of 125°C than at boiling temperature. At the same time it reduces the need of carrier by 50% (3.1).

3.3 Dyeing on the jet dyeing machine 130°C

Dyeing on the jet ensures optimum results. It increases evenness of dyeing and shortens the dyeing time to 30 min.

It is recommended to add 1-2 gm/litre of a carrier. Recommended temperature is 60°C while adding:

- x dispersion agent
- x carrier, if needed
- x dye

Raise 2°C per min.
Run 30 min.
Sample
Proceed as 3.1
Whether pre-setting is necessary depends on the structure of fabric.

3.4 Dyeing on the high-temperature beam dyeing machine at 125°C

This apparatus also ensures optimum dyeing but it is primarily suitable for the dyeing of warp and plain jersey fabrics. The after-scoured, dried and possibly heat-set material should be wound loosely and then be very tightly wrapped round the beam with a cotton runner.

3.5 Yarn dyeing on the HT machine

Proceed as under 3.3
Rapid dyeing, start temperature at 85-90°C
With:
- x dispersion agent
- x carrier if needed
- x dye

Close up lid, set machine under pressure, raise temperature to 1°C per min. to 130°C and run 20 min. then sample.

3.6 Fully fashioned articles can be dyed on paddle dyeing machines at boiling temperature or high temperature machines.