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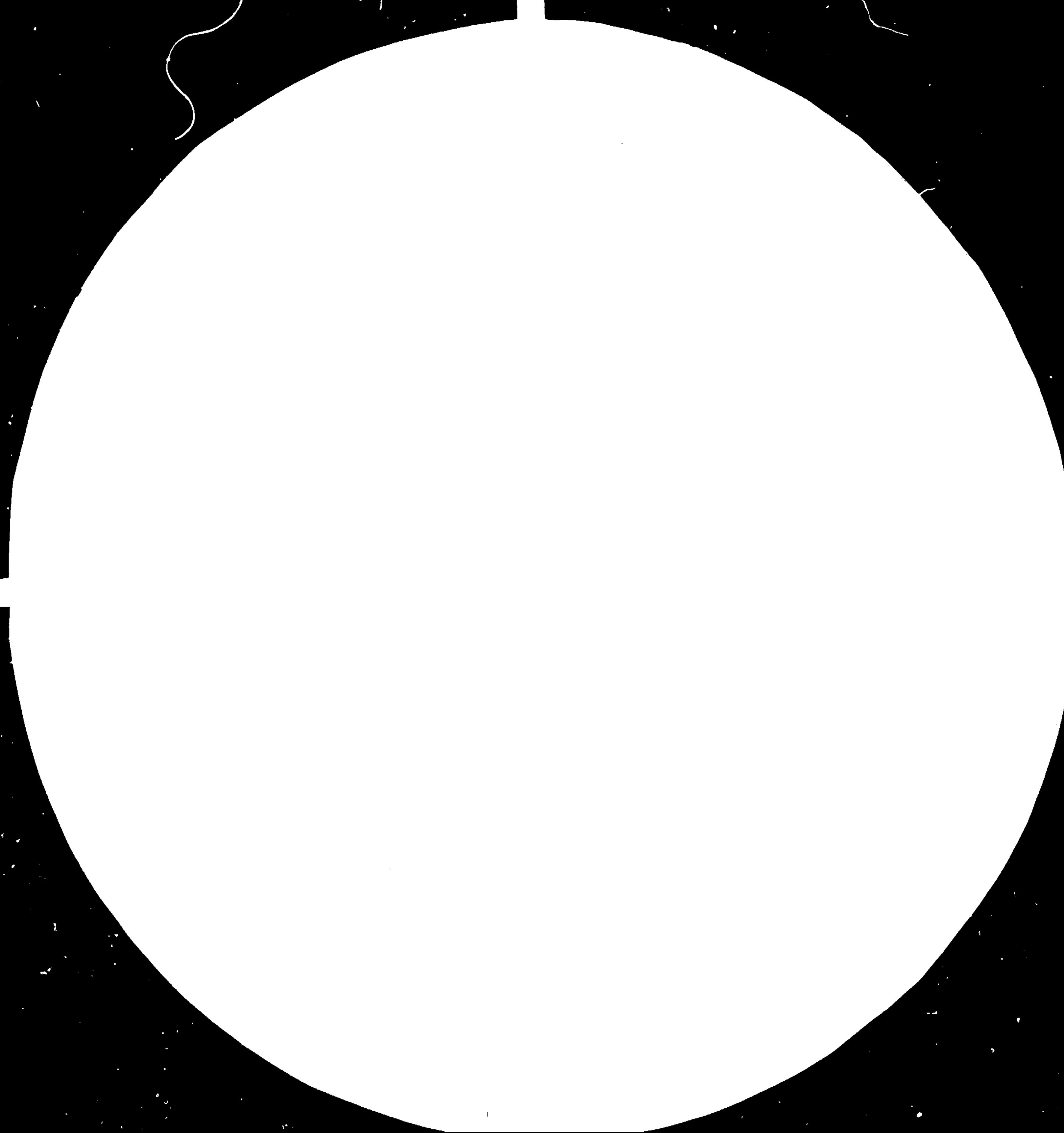

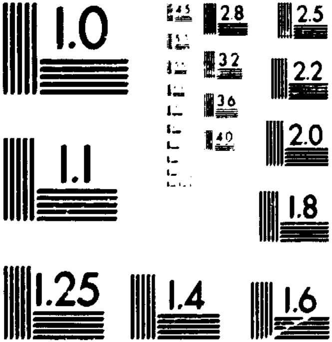

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DP/ID/SER.A/575
26 March 1985
ENGLISH

TEXTILE DEVELOPMENT CENTRE, PHASE II

DP/EGY/77/008

EGYPT

Technical Report: Dimensional Stability of Cotton Knitted Goods*

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

Based on the work of J. Gordon,
Expert in the Stability of Knitted Cotton

United Nations Industrial Development Organization
Vienna

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CONTENTS

INTRODUCTION

1.A. The Textile Development Centre

A Textile Development Centre has been set up over the past six years at the Textile consolidation Fund in Alexandria where there already exists a Textile Testing and Quality Control Organisation, itself the result of an earlier UNDP programme.

The purpose of the Textile Development Centre is to provide assistance to the textile industry through applied research and development activities in all aspects of textile manufacture from fibres to finished garments.

The Centre when fully established will have the objectives of:-

(i) providing pilot plant and testing laboratories for work on industrial problems of immediate use to the textile industry.

(ii) carrying out pilot plant studies of materials, particularly cotton and its blends, including fibres, dyes, finishes, machines and processes;

(III) carrying out quantitative and operational studies on industrial processes in textile mills to increase productivity and efficiency;

(iv) providing technical consultancy in management and technological problems and extending modern testing techniques to industry;

(v) Communicating to industry at all levels by organising seminars, conferences, symposia, group discussions and training courses;

(vi) Disseminating technical information to industry; and

(vii) Assisting the industry to set and maintain standards.

1.B. THE NATURE AND DURATION OF THE ASSIGNMENT

The purpose of the assignment was to carry out the duties as specified in section I.B. The assignment was for the one month from mid February 1983. Details of the work programme are given in appendix 1 but can be broken down into three main parts.

A) Assesment of procedures and conducting trials in the large knitting Company comprised 80% of the experts time when on station in Egypt.

B) Training at both TDC and mill staff by demonstrating a logical approach to practical problem solving.

C) Discussions with mill and TDC staff on applied research and fabric development programme.

2. ACTIVITIES

2.1 Direct Assistance through Technical Consultancy

A study was made of the organisation and flow patterns of fabric from the knitting mill through the dyeing and finishing and final making up departments at the EL-NASR Clothing and Textiles Co. (KABO).

A critical assessment was made of the bleaching, dyeing and finishing machinery currently in use at the company and recommendations were made as to the most suitable areas for further capital expenditure.

2.2 Processing Trials at KABO

The major part of the time available on station was taken up with the organisation and implementation of practical trials at KABO. These trials included the comparison of the continuous and batch bleaching methods that are currently in use, and the analysis of how these variations can affect the stability and final performance of the garments. Further trials assessed the efficiency of tubular mercerising on standard fabric constructions and especially knitted fabrics of differing stitch lengths. Details of these trials will be found in a series of technical reports in Appendix 3.

2.3 Visit to Private Sector Knitting Mill

A visit was made to a modern privately owned company to compare the equipment and procedure in use with those in the large public sector companies. Lengthy discussions were held with the management regarding their current technical problems, the most prominent of which were poor dimensional stability and weft distortion.

2.4 Instructions to Staff in Technical Investigations

Scientific and technical staff members of the TDC were instructed in the planning and practical implementation of processing trials. These trials were conducted so that the current performance could be critically analysed and recommendations for improvements could be made, where relevant.

2.5 Seminar

A one-day seminar on the processing of knitted fabrics was given on the 3rd March, 1983, at the TDC to an invited audience from the Egyptian Textile Industry and the staff of the TDC. The seminar was attended by 30 chemists and a lively discussion followed the presentation of papers which appear in Appendix 4.

3. RECOMMENDATIONS

3.1 Regarding the TDC

There is a need for greater co-operation between the staff of the TDC and the senior technologists within the weft knitting companies.

Discussions at both KABO and EL-MESSIRI indicate obvious areas where applied research and development at the TDC could lead to substantial improvements in the performance of weft knitted garments. A few examples are given below:-

(a) To estimate the bleaching efficiency that can be achieved with organo phosphate stabilisers in the Hydrogen Peroxide bleaching of knitted cotton. The current procedures use substantial quantities of Sodium Silicate and if this can be reduced or replaced by other stabilisers, then fabric with a reduced risk of stitch damage will be produced.

(b) To assess the wet on wet padding application of a range of substantive and non-substantive fabric softeners and stitch lubricants that could be economically applied at the stretching and de-watering stage of the finished process.

(c) Basic work is required to be undertaken to establish the optimum finished width of each knitted structure with regard to the yarn count and stretch length. This work could be usefully extended to include the various types of dyeing machines.

(d) The TDC could take an active roll in the technical assessment of recent advances in bleaching and dyeing procedures to see what modifications would be necessary for these to be successfully implemented into the Egyptian Industry.

3.2 Regarding the KABO Co.

(a) A regular meeting should be convened by the Research and Quality Manager to discuss the current levels of overall fabric performance, with the performance analysis presently being provided by the Quality Control Department being a good basis for discussion. The meeting would also be a suitable occasion to initiate further product or process developments. It is suggested that the General Managers of Knitting, Dyeing and Finishing and the making up depart ments should attend, along with the research and quality Manager.

(b) The initial work that was undertaken on the dimensional changes that occurred on processing the interlock and fine rib (TDC/TR1 & TDC/TR3) should be extended to cover the single jersey and warp knitted qualities. The width settings on the finishing calender specifications should be checked against the greige and relaxed dimensions to ensure that the same ratios are applied.

(c) The present testing facilities should be expanded, (i) to include a laboratory standard programmable washing machine and tumble dryer and (ii) to increase the range of colour fastness tests that can be undertaken to the specific I.S.O. standards.

(d) Regular checks should be instigated on the performance of the following machines that have been highlighted as having large positive or negative effects on the dimensional stability of the final fabric and garments:- Jemco bleach range, Tri-pad extractors, Fleissner drum dryers and Heliot calenders.

APPENDIX 1

WORK PROGRAMME

POST: 11-10/C/31.7.B EXPERT IN THE DIMENTIONAL STABILITY OF COTTON KNITTED GARMENTS.

NAME: JOHN GORDON.

FEBRUARY 1983.

10 Travel to Vienna.

11 UNIDO briefing.

12 Travel to Cairo.

13 UNIDO Cairo briefing/travel to Alexandria.

14 Discussions with the staff TDC

15 Visit to "KABO El-Nasr Clothing and Textiles Co.

16,17 KABO.

19 Discussions and training TDC staff.

20 Visit to El-Messiri at Mahalla.

21-24 KABO.

26 Prepare for seminar at TDC.

27-28 KABO.

MARCH

1-2 KABO.

3 Seminar at TDC.

5 Discussions on the results of trials at KABO.

6 Discussions and report writing at TDC.

7-8 KABO.

9 TDC/travel to Cairo.

10 UNDP debriefing Cairo (Notional)

11-23 Privite stay in Cairo at own expence

24 Travel from Cairo to Vienna.

25 UNIDO debriefing.

26 Travel to England.

APPENDIX 2

VISIT REPORTS

PRELIMINARY VISIT TO EL-NASR CLOTHING AND TEXTILES CO. (KABO) ALEXANDRIA ON TUESDAY 15th FEBRUARY 83.

JOHN GORDON
UNIDO Adviser on the Dyeing and Finishing of Knitted Fabrics

Summary

The main purpose of this visit was to confirm the co-operation of "KABO" in the assessments laid down in the Job Description. Trials were initiated to assess the changes in fabric dimensions that occurred by the alternative processing routes.

March 1983.

PERSONNEL

Accompanied by Eng. Soheir Seif El-Nasr we had initial meetings with Mr Samir T. El-Serafy chairman and Mr Hassan Yassin Technical and Production Director.

DISCUSSION

The main purpose of the visit was to be introduced to the chairman and Technical Director and confirm their co-operation in the assessment of their procedures, equipment and techniques and current dimentional stability levels as laid down in the Job Description.

The Chairman explained that they currently produce about 10.000 Doz garments a day and he expects this to rise to at least 16,000 Doz a day over the next three years. They currently employ 6,800 people.

The yarn is purchased from 6 or 7 suppliers, all of which are in the public sector, and the current consumption is around 20 tonne of yarn per day. A large percentage of the yarn has to be rewound and waxed prior to knitting.

Over 90% of the garments produced are underwear with outerwear comprising about 450 Doz. per day. At present exports account for between 6% and 10% of the production, and this includes some underwear for other middle eastern countries and outer-wear for western europe and the USA. A large part of the projected growth is growth in exports to western europe.

Whilst the company are aware that some of the garments have poor dimentional stability to machine washing, It has not been a draw-back to their growth in either the home market or the exports to other middle eastern markets. But this might not be the case when attempting to increase sales to western europe.

After a tour of the factory a further meeting was held with Mr Farouk Fathi Aglan, General Manager Dyeing and Finishing and Mr Abd El-Monem Abaza General Manager Knitting to instigate the trial coverd in TDC/TR.1 and TDC/TR.2.

I would like to thank the following individuals within "KABO" for there help and cooperation during my stay.

Mr Samir T. El Serafy	Chairman.
Dipl. Ing Hassan Yassin	Technical and Production Director.
Mr Farouk Fathi Aglan	General Manager Dyeing & Finishing
Eng. Abd El-KHALIK A. YASSIN	Research and Quality Control Manager
Eng. Abd El-Monem Abaza	General Manager Knitting.
Eng. Aida Boutrous Barsoum	General Manager outerwear making-up.
Eng. Moltazm Abdel Monem Sileem.	Dyehouse Manager.
Eng. Omar El-Kadim	Knitting Manager.
Eng. Ahmed Said Hassam	Deputy Quality Control Manager.
Eng. Mohamed Ahmed Elbanna	Quality Testing Manager.

VISIT . EL-MESSIRY & CO. (EL GHARBIA INDUSTRIAL COMPANY)
MEHALLA EL-KOBRA, ON SUNDAY 20TH FEBRUARY 1983.

JOHN GORDON

UNIDO Adviser on the Dyeing and Finishing of Knitted Fabrics

Summary

A visit was made to El-Messiry, who are a modern size vertically integrated weft knitting company who export half of their production. After spending some time assessing the current methods a number of recommendations were made to help overcome problem of dimensional stability and fabric distortion.

March 1983.

INTRODUCTION

The writer was introduced to the company by Mr A. B. Khairallah Director of mill services and Dr Hosney M.M. Hassanin along with Dr J. G. Roberts UNIDO Adviser on Energy Conservation. After initial discussions and a "Request for Data" regarding the energy conservation survey a tour was made of the factory.

The writer then spent the day in assessing production procedures and discussing current problems with the management whilst the other members of the party made a visit to another company.

Discussions were held with Mr M. Nabil El-Messiri, Eng Sayed and Eng. A. R. Elrefaey.

DISCUSSIONS

El-Messiri and Co. are a privately owned vertically integrated company with weft knitting, dyeing and finishing and garment making facilities. Approximately 50% of their production is exported and of this just over half goes to western europe and the USA. With the remaindergoing to eastern europe.

The major exports are of coloured T shirts of meduim Quality whilst underwear makes up the major part of their local business. Currently 1.5 Tonne of fabric is knitted and finished per day of which 1.25 Tonne is finished in white and 0.25 Tonne is piece dyed.

They purchase yarn from 4 or 5 spinning companies in the public sector with 1/30cc and 1/24cc carded yarn making up the vast majority of their consumption. Some yarn is rewound on a leesona rotaconer but the majority is used directly as supplied without re-winding. It's poor quality gives rise to a large amount of comment and dissatisfaction.

The knitting mill currently has 15 circular machines comprising 4 single jersey (Textima and Singer) and 11 machines producing fine rib and interlock (Albi and Terrot) with the various body width diameters available. All the machines are fitted with either positive feed (Single jersey) or storage units (Albi and Terrot). The fabric going into export garments is inspected in the grey on a newly installed AB calator tubular inspection machine.

The dyeing and finishing department comprises nine atmospheric winch dyeing machines and one gaston county aqualuft two tube jet, one new tube-tex tri-pad and an older tube-tex extractor pad. Tubular fabric drying is carried out on a tube-tex drum dryer and a newly installed fleissner drum dryer. The final calendering is done on a tube-tex and a betexima calender. The gaston county jet, which has been running for just under a year has been dogged by a number of small mechnical problems. A further jet dyeing machine has been ordered from Thies to increase the capacity. A Thies high temperature package dyeing machine has also been installed to dye polyester/cotton yarn the majority of which goes into colour woven fabrics. The company undertake commission dyeing and finishing of both tubular cotton and jet dyes woven polyester/cotton.

FINDINGS

Whilst the company are keen to improve the dimentional stability, they do not have a washing machine or tumble dryer, so no inhouse stability tests can be undertaken.

The most severe problem I encountered was fabric distortion. After the winch bleaching stage the fabric was relaxed and undistorted but the tube-tex tri-pad was causing substantial length extension and bow distortion. A bow of 8 cm was measured on a flat tube width of 35 cm. This distortion was then carried right through to the finished garments. It was recommended that a shorter path be arranged between the fabric in the wagon and the tri-pad, and that the tri-pad width and overfeed be adjusted to enable the distortion to be reduced. If no improvement was achieved then it was recommended to hydro-extract the fabric for export.

A further problem was stitch damage and poor fabric recovery especially on sulpher dyed navy and black shades. It was recommended that a silicone lubricant be applied to these fabrics at the tri-pad.

APPENDIX 3

TECHNICAL REPORTS

TECHNICAL REPORT

ASSESMENT OF DIMENTIONAL CHANGES THAT OCCUR DURING PROCESSING AT EL NASR CLOTHING AND TEXTILES CO (KABO) ALEX.

JOHN GORDON

UNIDO Adviser on Dyeing and Finishing of Weft Knitted Fabric

Summary

The two major bleaching methods in use at KABO have been compared to assess the change that occur in both dimensions and final dimentional stability.

March 1983.

DISCUSSION

The wet processing departments at KABO handle 20 tons of weft knitted cotton fabric per day. The majority of this is bleached on either a Jemco continuous double J-box machine or atmospheric winches. The remainder of the fabric is dyed on either high temperature or atmospheric jets and winch dyeing machines.

The first trial was undertaken to assess the difference in dimentions that can occur by using the two types of machine that are commonly used for bleaching. A 20 gauge interlock produced from 1/30cc carded yarn was chosen for this trial

FINDINGS

The results of this trial, on the attached table, show clearly that the processing has a major affect on the fabric dimentions. In many ways it is wrong to carry on classifying the two finished fabrics as the same quality.

After winch bleaching the fabric is as close to the fully relaxed reference state as is possible. Any length extension in the subsequent processing will only be temporary and will be released in laundering of the garments. The Jemco machine is causing substantial length extension, partially due to the long upward travel of the fabric rope. Reduced fabric loading in the two J-box may help to decrease the extension by allowing fabric shrinkage to occur under the conditions of reduced fabric loading and higher liquor to goods ratio.

The wet processing steps after bleaching increased the fabric extension. The area of most concern being the fleissner four drum dyers as it should be possible to slightly overfeed on this machine and therefore reduce rather than increase the potential shrinkage.

If the fabric had been calendered at the bleached dimensions then the shrinkage that would occur after one 60^{0}C wash cycle would be:-

	LENGTH	WIDTH
Winch bleach	-3.4%	-3.3%
Jemco bleach	-12.0%	-1.5%

The shrinkage of the winch bleached fabric increased by only a small amount after a further four 60^{0}C wash cycles.

On presentation of these findings to Mr Hassan Yassin, the technical and production director, I was requested to extend the study to cover the other major fabrics and processing routes.

20 GAUGE INTERLOCK 1/30cc CARDED YARN

PRODUCTION (STEPS)	JEMCO BLEACH				WINCH BLEACH			
	CUMULATIVE % CHANGE		% CHANGE OF EACH STEP		CUMULATIVE % CHANGE		% CHANGE OF EACH STEP.	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
Greige fabric	0	0			0	0		
After bleach	+12.4%	-16.3%	+12.4%	-16.3%	-3.6%	-7.4%	-3.6%	-7.4%
TRI-PAD Extraction (WITH STRETCHER)	+14.5%	-12.8%	+2.1%	+6.4%	+3.0%	-6.6%	+6.6%	+0.8%
Fleissner Dryer .	+20.4%	-22.1%	+8.0%	-9.3%	+15.0%	-13.0%	+12.0%	-6.4%
Heliot callender (with stretcher)	+19.0%	-14.8%	-1.4%	+7.2%	+9.8%	-13.5%	-5.2%	-0.5%
After 48 hrs relaxation.	+18.4%	-15.2%	-0.6%	-0.4%	+9.0%	-13.5%	-0.8%	0
1 wash cycle A 60°C + flat dry.	+ 4.8%	-15.0%	-13.6%	-0.2%	-4.6%	-9.4%	-13.6%	+4.5%
2 ,, ,, ,,	+1.4%	-13.8%	-3.6%	-1.2%	-7.0%	-9.3%	-2.4%	0
3 ,, ,, ,,	+0.3%	-14.8%	-1.1%	+1.0%	-7.0%	-10.7%	0	-1.4%
4 ,, ,, ,,	-0.8%	-13.8%	-1.1%	-1.0%	-7.6%	-9.3%	-0.6%	+1.4%
5 ,, ,, ,,	-0.8%	-13.4%	0	-0.4%	-7.2%	-10.5%	0	-1.2%

TECHNICAL REPORT

ASSESMENT OF TUBULAR MERCERIZATION OF A SINGLE JERSEY FABRIC AT EL-NASR CLOTHING AND TEXTILES CO (KABO) ALEX.

JOHN GORDON

UNIDO Adviser on Dyeing and Finishing of Weft Knitted Fabric

Summary

A dornier tubular mercerizing machine has recently been installed in KABO. A trial was conducted on this machine to asses the resultant changes in apperance and performance. It was found that there were no improvements in Dimentional Stability and further changes were required to both the fabric structure and the mercerizing conditions.

March 1983

DISCUSSION

A dornier tubular mercerizing machine has recently been installed in the dyehouse. It is currently running only ½ to 1 day per week as the effect of fabric mercerization has not been correlated to the changes of performance and dimensions that occur. Therefore Mr Hassan Yassin asked me to spend some time studying the machine performance.

A trial was carried out using a 18 gauge single jersey fabric made from 2/60.5 cc combed and singed yarn, knitted on a 4 feeder mailleuse link machine. This fabric had already been earmarked for processing by piece mercerization and Jemco bleaching.

The dornier machine comprises an impregnation stage where the fabric is immersed in 30°Be caustic soda, followed by a squeeze mangle. The fabric is skied over rollers for two minutes to allow the chemical reaction to occur, followed by passage over three tubular "cigars". The fabric is spray rinsed during passage over the "cigars" whilst the diameters of the three "cigars" is progressively reduced from the first to third. For this trial the fabric was run at 12 metre per minute with the first cigar set at the tube width, the second at-10% andthe third at-20%

FINDINGS

The fabric processed on the dornier mercerization underwent major changes to it's structure and appearance. The fact that during Jemco bleaching the fabric shrank 7.8% in length, whereas the unmercerized piece was extended by 16.4% in length, shows the extermely high degree of tension that the fabric has been subjected too. Dornier claim, without specifying the test, that optimal dimensional stability figures of 3% are achievable Clearly the 7% length shrinkage after one wash and 12.3% shrinkage after five washes are nowhere near this. But again, if the fabric had been winch bleached and finished out at the same dimensions then a highly lustrous stable fabric would have been produced.

The final fabric has a lustrous appearance but with poor coverage and recovery, due to the low weight and courses. A second trial was initiated using a 28 gauge interlock, but on seeing the final results of this trial I was requested to undertake a larger study comprisng both changes to the knitted structure and the finishing conditions.

2/60cc COMBED + YARN SINGED

MERCERIZATION TRIALS ON SINGLE JERSEY

MALLEUSE LINK MACHINE 4 FEEDER 18 GAUGE QUALITY NO 62413

	MERCERISED FABRIC				NON-MERCERISED			
PRODUCTION STEPS	CUMULATIVE % CHANGE		% CHANGE ON EACH STEP		CUMULATIVE % CHANGE		% CHANGE ON EACH STEP	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
Greige fabric	0	0			0	0		
After dornier mercerization	+35.0%	-38.0%	+35%	-38.0%				
After Jemco bleach	+27.2%	-33.3%	-7.8%	-4.7%	+16.4%	-20.2%	+16.4%	-20.2%
Tri-pad extraction (with stretcher)	+28.6%	-32.5%	+1.4%	+0.8%	+17.8%	-15.4%	+1.4%	+4.8%
Fleissner Dryer	+36.0%	-40.5%	+7.4%	-8.0%	+25.8%	-26.0%	+8.0%	-10.6%
Selict callender	+34.8%	-38.0%	-1.2%	+2.5%	+22.6%	-16.3%	-3.2%	+9.7%
After 48 Hrs relaxation	+34.3%	-36.8%	-0.5%	+1.2%	+21.6%	-17.5%	-1.0%	-1.2%
1 wash cycle at 60°C + flat dry	+27.3%	-34.3%	-7.0%	-2.5%	+5.7%	-19.1%	-15.9%	-1.6%
2 ,, ,, ,,	+24.8%	-35.1%	-2.5%	+0.8%	+4.2%	-19.1%	-1.5%	0
3 ,, ,, ,,	+23.6%	-34.8%	-1.2%	-0.3%	+4.6%	-19.1%	+0.4%	0
4 ,, ,, ,,	+22.0%	-34.8%	-1.6%	0	+5.3%	-18.1%	+0.7%	0
5 ,, ,, ,,	+22.0%	-33.2%	0	-0.4%	+2.7%	-18.5%	-2.6%	-0.6%

TECHNICAL REPORT

ASSESMENT OF DIMENTIONAL CHANGES THAT OCCUR DURING THE BLEACHING AND DYEING OF FINE RIB AT EL NASR CLOTHING & TEXTILE CO (KABO) ALEXANDRIA

JOHN GORDON

UNIDO Adviser on Dyeing and Finishing of Weft Knitted Fabrics

Summary

As an extension of technical report TDC/TR1 a comparison has been made of bleaching and dyeing methods in current use at KABO. The findings indicate a number of area's that require changes to be made to either knitting construction or processing conditions to improve the **dimensional** stability of the final product.

March 1983.

INTRODUCTION

The results of technical report TDC/TR1 indicated the dimensional change that occurred during the alternative bleaching procedures on a 20 gauge interlock fabric. The trial was repeated and enlarged using a 18 gauge fine rib quality No 21814 produced from 1/33cc combed yarn.

The current trial compared Jemco bleaching, winch bleaching, winch dyeing and Thies softstream jet dyeing. The bleaching trials used fabric from the 18 inch diameter machines and the dyeing trial used fabric from 20 inch diameter cylinders of the same fabric construction. The dyeings were carried out using hot dyeing reactive dyestuffs to a similar depth of shade.

FINDINGS

Clearly the dyed fabric had greater relaxation than the winch bleached fabric. This increase was brought about by the longer processing time at elevated temperatures required to dye the fabric.

The Thies softstream jet dyeing machine produced slightly less length relaxation than the winch dyeing machine but the subsequent washing shrinkage results showed that the jet dyed fabric shrank to almost exactly the length dimensions of the fabric coming out of the winch.

The shrinkage on one wash from the calendered dimensions are:-

	LENGTH	WIDTH
Winch dye	-7.7%	-13.0%
Jet dye	-11.0%	-12.2%

The ratio of the width settings on the Heliot calender do not correlate for this quality with the fabric dimensions from the different cylinder diameters. The calender settings for the 18 inch diameter being 15% under the greige width and the 20 inch diameter being 11% under the greige width.

The calender settings for the dyed fabric of -11% under the greige width is unrealistic as after only one wash the fabric reverts to -23.5% and -24.5% respectively causing a shrinkage of 12.5 to 13.0% in the width. If a flat tube width of between 49 and 50 cms, which equates to the current -11% calendered setting, is required then either a larger cylinder diameter or a substantial change in knitting construction must be made.

For the bleached only fabric, which does not attain the same degree of relaxation, the final calender settings are a lot more realistic, achieving width shrinkages of between 2.5% and 4.0% after five washes. The Jemco bleaching range caused a length extension of 7.6% over the winch bleached fabric, but this is only half of the 16% overall difference that the 20 gauge interlock.

One area of major concern is still the degree of length extension that occurs after the bleaching or dyeing stage. This extension is only temporary and is the major cause of length shrinkage on susequent washing.

The tri-pad and fleissner dryers are the largest cause of this extension. An alternative de watering method by hydro extraction is available. This will not cause the same degree of extension as the tri-pad, and might therefore, be more suitable for fabric going to be exported.

On investigating the comparative settings on the fleissner dryers it was found that the imput conveyor speed was running 25% slower than the speed of the first drying drum. This clearly would be a major cause of extension, the settings were subsequently changed to balance the input conveyor and the drum speeds. It would be preferable to have a slight over-feed of the fabric on to the drums but this has caused problems in the past as the circulating airflow does not help the fabric on to the drum.

A small trial using winch dyed fine rib was carried out after the adjustment was made and showed a reduction in extension down to 2.3% which compares favourably with the 6.2% and 9.8% recorded in this trial.

FINE RIB QUALITY 21814 20 "DIAMETER 1/33's COMBED YARN

PRODUCTION STEPS	SOFTSREHM JET DYE				WINCH DYE			
	CUMULATIVE % CHANGE		% CHANGE ON EACH STEP		CUMULATIVE % CHANGE		% CHANGE ON EACH STEP	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
Greige fabric	0	0			0	0		
After dyeing	-6.4%	-22.0%	-6.4%	-22.0%	-9.6%	-20.0%	-9.6%	-20.0%
Tri-pad extraction (with stretcher).	+0.8%	-20.4%	+7.2%	+1.6%	-5.0%	-18.2%	+4.6%	+1.8%
Fleissner dryer	+7.0%	-30.0%	+6.2%	-9.6%	+4.8%	-30.0%	+9.8%	11.8%
Heliot calender (with stretcher)	+5.4%	-11.3%	-1.6%	+18.7	-0.5%	-11.5%	-5.3%	-18.5%
After 48 hrs relaxation.	+4.4%	-14.0%	-1.0%	-2.7%	-0.65%	-16.25%	-0.15%	-4.75%
1 wash cycle at	[illegible]	-23.5%	-10.0%	-9.5%	-8.2%	-24.5%	-7.55%	-8.25%
2 ,, ,,	[illegible]	-23.5%	-2.4%	0	-10.4%	-24.0%	-2.2%	+0.5%
3 ,, ,,	[illegible]	-25.2%	0	-1.7%	-9.8%	-22.5%	-0.6%	+1.5%
4 ,, ,,	[illegible]	-23.1%	-1.7	+2.1%	-9.6%	-22.8%	-0.2%	-0.3%
5 ,, ,,	[illegible]	-23.5%	0	-0.4%	-9.6%	-23.2%	0	-0.4%

FINE RIB QUALITY 21814 18 "DIAMETER 1/33 cc COMBED YARN

PRODUCTION STEPS	JEMCO BLEACH CUMULATIVE % CHANGE		JEMCO BLEACH % CHANGE ON EACH STEP		WINCH BLEACH CUMULATIVE % CHANGE		WINCH BLEACH % CHANGE ON EACH STEP	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
Greige fabric	0	0			0	0		
After bleach	+2.0%	-13.0%	+2.0%	-13.0%	-5.6%	-16.8%	-5.6%	-16.8%
Tri-pad extraction (With stetcher)	+7.2%	-15.0%	+5.2%	-2.0%	+6.0%	-17.6%	11.0%	-0.8%
Fleissner dryer.	+13.8%	-20.6%	+66%	-5.6%	+10.6%	-20.6%	+4.6%	-2.0%
Heliot calender	+12.8%	-15.1%	-1.0%	+5.5%	+11.6%	-16.5%	+1.0%	+4.1%
After 48 hrs relaxation	+12.6%	-15.8%	-0.2%	-0.7%	+11.0%	-17.6%	-0.6%	-1.1%
1 wash cycle at 60°C+flat dry	+2.5%	-17.6%	-10.1%	-1.8%	0	-20.4%	-11.0%	-2.8%
2 ,, ,, ,,	+1.2%	-16.6%	-3.7%	+1.0%	-2.0%	-19.8%	-2.0%	+0.6%
3 ,, ,, ,,	-0.5%	-17.4%	-0.7%	-1.2%	-1.7%	-21.0%	+0.3%	-1.2%
4 ,, ,, ,,	-3.0%	-18.3%	-2.5%	-0.9%	-2.2%	-21.0%	-0.5%	0

TECHNICAL REPORT

ASSESMENT OF TUBULAR MERCERIZATION OF A 28 GAUGE INTERLOCK FABRIC AT EL-NASR CLOTHING & TEXTILES CO. (KABO) - ALEXANDRIA

JOHN GORDON
UNIDO Adviser on Dyeing and Finishing of Weft Knitted Fabrics

Summary

A further trial was conducted on the machine to asses the changes in appearance and performance on a 28 gauge interlock. In this case there was substantial improvements to the fabric by mercerisation.

March 1983.

INTRODUCTION

The findings of technical report TDC/TR3 indicated that quality No.62413 was clearly not a suitable fabric to undergo tubular mercerisation, as an aid to improve fabric stability and performance the current trial was initiated before the results of TDC/TR2 has been discussed with Mr. Hassan Yassin. He requested me to undertake a larger study, comprising both changes to the knitted structure and the finishing conditions.

This trial was undertaken using a 28 gauge interlock fabric produced from 1/70cc combed yarn.

FINDINGS

The mercerised fabric again showed major changes to dimensions and appearance. The permanent length extension of 28% from the greige fabric is basicaly too high. Investigation of the machine did not highlight any methods of reducing the tension. The only possible way is to try to hold out the width on the cigars which may reduce the amount of yarn available to extend the loop.

The 6.4% length extension that occurred between the bleaching and calendering steps comprised the total shrinkage on five washes. The width shrinkage was only 1.8% from the callendered and relaxed condition. This is clearly far superior to the previous trial and after the final garment pressing it is likely that the dimensional changes to washing would be down to approximately 4.5% length and 2.0% width shrinkage. It is noteable that the calendered width was below both the dried and final relaxed width and should, therefore, have been set slightly wider.

The unmercerised fabric has high length shrinkage caused by the extensions that have occurred during wet processing.

In conclusion the appearance and dimensional stability of this fabric were substantially improved by tubular mercerisation.

MERCERIZATION TRIALS ON 28 GAUGE INTERLOCK PRODUCED FROM 1/70cc COMBED YARN

PRODUCTION STEPS	MERCERISED FABRIC				NON-MERCERISED			
	CUMULATIVE % CHANGE		% CHANGE ON EACH STEP		CUMULATIVE % CHANGE		% CHANGE ON EACH STEP	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
Greige fabric	0	0			0	0		
After dornier mercerization	+34.8%	-47.0%	+34.8%	-47.0%	0	0	0	0
After Jemco bleach	+28.2%	-27.6%	-7.0%	+19.4%	+18.6%	-21.0%	+18.6%	-21.0%
Tri-pad extraction (with stretcher)	+30.4%	-33.1%	+2.2%	-5.5%	+19.4%	-13.0%	+0.8%	+8.0%
Fleissner dryer	+35.1	-40.0%	+4.7%	-6.9%	+25.9%	+4.2%	+6.5%	-1.2%
Heliot calender	+34.6%	-35.7%	-0.5%	+4.3%	+25.7%	-19.2%	-0.2%	-5.0%
After 48 hrs extraction	+33.2%	-37.1%	-1.4%	-1.4%	+21.4%	-20.4%	-4.3%	-0.6%
1 wash cycle at 60°C + flat dry	+29.0%	-36.7%	-4.2%	+0.4%	+12.6%	-23.0%	-8.8%	-2.6%
2 ,, ,, ,,	+28.2%	-35.6%	-0.8%	-1.1%	+8.9%	-23.0%	-3.7%	0
3 ,, ,, ,,	+29.4%	-36.8%	+1.2%	+1.2%	+7.0%	-21.0%	-1.9%	+2.0%
4 ,, ,, ,,	+28.7%	-36.8%	-0.7%	0	+4.2%	-20.5%	-2.8%	+0.5%
5 ,, ,, ,,	+28.0%	-35.3%	-0.7%	-1.5%	+4.9%	-21.0%	+0.7%	-0.5%

TECHNICAL REPORT

ASSESMENT OF TUBULAR MERCERIZATION ON A 28 GAUGE SINGLE JERSEY FABRIC AND A 24 GAUGE SINGLE JERSEY FABRIC AT EL-NASR CLOTHING AND TEXTILES CO. (KABO)

ENG. Soheir Seif El-Nasr
Textile Development Centre.

Summary

A three major trial were conducted on a donrier tubular mercerizing machine has recently been installed in KABO have been compared to assess the change that occur in both dimensions and final dimensional stability.

March 1983.

DISCUSSION

Due to the effect of fabric mercerization has not been correlated to the changes of performance and dimensions that occur. The three trials were carried out using a 28 gauge single jersey fabric made from 40/1 combed yarn and 24 gauge single jersey fabric made from 33/1 combed yarn.

This fabric had already been earmarked for processing.

1st trial was the fabric is bleached ... a Jemco continuous double J-box machine.

2nd trial the fabric was spray rinsed during passage over the "Cigars" whilst the diameters of the "Cigars" is progressively reduced.
The first cigar set at the tube width, the second at -5% and the third at -10%.

3rd trial was the fabric is spray rinsed during passage over the "Cigars" whilst the diameters of the "Cigars" is progressively reduced.
The first cigar set at the tube width, the second at -10% and the third at -20% .

Findings

The results of the trials on the attached tables show clearly that the processing has a major affect on the fabric dimensions.

1. **There is a substantial reduction in courses in the fabric after mercerization, therefore have to knit to a high course rate to help overcome this.**

2. The setting of the cigar width effects the length extention on mercerization.
   Wider cigar → less extension.
   As there is less yarn available to extend the loop.

3. Further trials using cigar width at relaxed width followed by cigars at -10% of the relaxed width, this should not have a major affect on fabric width but it will on length extension.

SINGLE JERSEY **QUALITY** 1080 40/1 COMBED YARN **GAUGE 28**

PRODUCTION STEPS	BLEACHING (1377) CUMULATIVE % CHANGE		MERCERISED -10% (1378) CUMULATIVE % CHANGE		MERCERISED -20% (1918) CUMULATIVE % CHANGE	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
GREIGE FABRIC	0	0	0	0	0	0
AFTER DORNIER MERCERIZATION	-	-	+27.2%	-29.3%	+37.2%	-34.6%
AFTER JEMCO BLEACH	+7.2%	-15.5%	+25.2%	-24.9%	+17.8%	-29.0%
TRI-PAD EXTRACTION (WITH STRETCHER)	+8.0%	-14.6%	+25.8%	-25.4%	+31.0%	-27.4%
FLEISSNER DRYER	+8.2%	-13.2%	+19.4%	-27.6%	+33.2%	-30.2%
HELIOT CALLENDER	+15.6%	-14.6%	+13.6%	-13.6%	+28.8%	-20.0%
1st wash cycle at 60°C + flat dry	+6.4%	+14.2%	-14.2%	+24.7%	+28.0%	-27.0%
2nd " "	+4.4%	+15.1%	+22.8%	+22.1%	+27.8%	-29.4%
3rd " "	+4.4%	-14.6%	+15.2%	-22.7%	+28.2%	-29.8%
4th " "	+2.4%	-15.5%	+13.2%	-22.1%	+27.2%	-29.4%
5th " "	+4.4%	-14.8%	+12.4%	-21.9%	+27.8%	-29.4%

FABRIC SPECIFICATION

	SAMPLE NO	WIDTH Cm	COURSES 10Cm	WALES/ 10Cm	WEIGHT/ SQUARE M.	STITCH LENGTH
GREIGE FABRIC	1080	48.5	225	169	124	2.3
BLEACHING	1377	42.7	202	197	123	2.3
MERCERISED - 10%	1378	39	181	204	119	2.2
MERCERISED - 20%	1918	39.5	164	209	114	2.4

SINGLE JERSEY QUALITY 1081 40/1 COMBED YARN GAUGE 28

PRODUCTION STEPS	BLEACHING (1919) CUMULATIVE % CHANGE		MERCERISED - 10% (1919) R CUMULATIVE % CHANGE		MERCERISED - 20% (1990) CUMULATIVE % CHANGE	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
GREIGE FABRIC	0	0	0	0	0	0
AFTER DORNIER MERCERIZATION			+42.6%	-37.9%	+30.2%	-21.5%
AFTER JEMCO BLEACH	+8.0%	-16.5%	+33.8%	-28.0%	+24.4%	-28.8%
TRI-PAD EXTRACTION (WITH STRETCHER)	-11.8%	-13.4%	+34.8%	-30.6%	+30.0%	-27.2%
FLEISSNER DRYER	+10.0%	-16.5%	+32.2%	-31.0%	+39.2%	-29.2%
HELIOT CALLENDER	+14.2%	-14.5%	+28.8%	-22.1%	+33.9%	-27.2%
1st wash cycle at 60°C + flat dry	+1.4%	-15.4%	+29.0%	-32%	+31.2%	-27.2%
2nd " "	+2.8%	-14.4%	+27.4%	-27.8%	+30.4%	-27.6%
3rd " "	+2.4%	-15.7%	+29.8%	-26.6%	+30.4%	-28.4%
4th " "	+1.4%	-15.0%	+28.6%	-28.0%	+29.6%	-27.6%
5th " "	-0.6%	-15.0%	+28.0%	-27.0%	+31.0%	-28.2%

FABRIC SPECIFICATION

	SAMPLE NO	WIDTH Cm	COURSES 10 Cm	WALES/ 10 Cm	WEIGHT/ SQUARE M.	STITCH LENGTH
GREIGE FABRIC	1081	54.9	219	147	113	2.5
BLEACHING	1919	34.4	183	191	114	2.5
MERCERISED - 10%	(1919)R	39.7	157	200	113	2.4
MERCERISED - 20%	1990	39.5	160	209	112	2.4

SINGLE JERSEY QUALITY 4285 40/1 COMBED YARN GAUGE 28

PRODUCTION STEPS	BLEACHING (233) CUMULATIVE % CHANGE		MERCERISED -10% (9922) CUMULATIVE % CHANGE		MERCERISED -20% (316) CUMULATIVE % CHANGE	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
GREIGE FABRIC	0	0	0	0	0	0
AFTER DORNIER MERCERIZATION	-	-	+38.6%	-37.4%	+41.0%	-39.1%
AFTER JEMCO BLEACH	+7.0%	-13.9%	+32.6%	-33.4%	+35.6%	-32.8%
TRI-PAD EXTRACTION (WITH STRETCHER)	+8.8%	-13.3%	+31.6%	-32.3%	+33.4%	-30.7%
FLEISSNER DRYER	+11.6%	-16.4%	+36.0%	-36.3%	+34.6%	-34.1%
HELIOT CALLENDER	+10.4%	-15.1%	+28.0%	-22.9%	+31.6%	-27.9%
1st WASH CYCLE AT 60°C + FLAT DRY	+2.0%	-14.0%	+26.8%	-30.7%	+29.0%	-31.4%
2nd " "	-0.4%	-13.9%	+26.8%	-32.4%	+28.2%	-31.6%
3rd " "	-2.0%	-14.7%	+26.0%	-32.0%	+26.4%	-31.6%
4th " "	-4.8%	-14.5%	+25.2%	-31.4%	+24.2%	-31.2%
5th " "	-3.8%	+2.5%	+22.6%	-31.4%	+23.8%	-30.8%

FABRIC SPECIFICATION

	SAMPLE NO	WIDTH Cm	COURSES 10Cm	WALES/ 10 Cm	WEIGHT/ SQUARE M.	STITCH LENGTH
GREIGE FABRIC	4285	50.2	165	155	100	2.8
BLEACHING	233	44.2	161	180	105	2.7
MERCERISED - 10%	9922	39.2	136	190	99	2.6
MERCERISED - 20%	316	36.5	129	213	105	2.2

SINGLE JERSEY QUALITY 3080 33/1 COMBED YARN GAUGE 24

PRODUCTION STEPS	BLEACHING (4020) CUMULATIVE % CHANGE		MERCERISED -10% (4020) R CUMULATIVE % CHANGE		MERCERISED -20% (4021) CUMULATIVE % CHANGE	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
GREIGE FABRIC	0	0	0	0	0	0
AFTER DORNIER MERCERIZATION	-	-	+46%	-42.9%	+36.4%	-40.4%
AFTER JEMCO BLEACH	+12%	-19.8%	+51.6%	-38.3%	+32.6%	-35.7%
TRI-PAD EXTRACTION (WITH STRETCHER)	+14.4	-20.2%	+38.6%	-37.8%	+29.8%	-32.0%
FLEISSNER DRYER	+11.6%	-22.1%	+40.6%	-40.3%	+32.0%	-36.3%
HELIOT calender	+15.0%	-20.4%	+29.0%	-33.1%	+32.0%	-36.3%
1ST WASHCYCLE AT 60°C + FLAT DRY	+3.0%	-19.3%	+33.0%	-35.8%	+26.5%	-35.3%
2ND ,, ,,	+1.4%	-19.5%	+33.0%	-36.3%	+25.6%	-35.1%
3RD ,, ,,	+2.2%	-19.1%	+34.2%	+36.7%	+27.2%	-35.5%
4TH ,, ,,	+0.6%	-18.9%	+30.2	-36.7%	+24.8%	-35.3%
5TH ,, ,,	-	-18.3%	+31.2%	-37.3%	+25.4%	-34.4%

FABRIC SPECIFICATION

	SAMPLE NO	WIDTH Cm	COURSES 10Cm	WALES/ 10Cm	WEIGHT/ SQUARE M.	STITCH LENGTH
GREIGE FABRIC	3080	54.7	183	125	116	2.8
BLEACHING	4020	43	150	164	115	2.9
MERCERISED- 10%	4020 R	39	132	178	120	2.8
MERCERISED- 20%	4021	36.9	135	192	126	2.8

SINGLE JERSEY QUALITY 3046 33/1 COMBED YARN GAUGE 24

PRODUCTION STEPS	BLEACHING (340) CUMULATIVE % CHANGE		MERCERISED -10% (125) CUMULATIVE % CHANGE		MERCERISED -20% (315) CUMULATIVE % CHANGE	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
GREIGE FABRIC	0	0	0	0	0	0
AFTER DORNIER MERCERIZATION	-	-	+39.2%	-38.3%	34.4%	-35.3%
AFTER JEMCO BLEACH	+8.8%	-15.5%	+28.8%	-34.3%	+30.0%	-31.3%
TRI-PAD EXTRACTION (WITH STRETCHER)	+11.2%	-18.6%	+30.2%	-32.3%	+29.0%	-29.2%
FLEISSNER DRYER	+22.2%	-19.4%	+34.2%	-36.9%	+31.8%	-31.5%
HELIOT calender	+19.4%	-16.5%	+25.6%	-23.5%	+24.8%	-22.8%
1ST WASH CYCLE AT 60°C + FLAT DRY	+4.6%	-15.7%	+24.6%	-31.4%	+25.8%	-31.7%
2ND ,, ,,	+3.0%	-17.4%	+25.6%	-32.5%	+23.4%	-30.1%
3RD ,, ,,	+3.8%	-17.2%	+26.8%	-32.7%	+25.0%	-31.1%
4TH ,, ,,	-1.2%	-17.2%	+22.8%	-32.3%	+24.4%	-31.3%
5TH ,, ,,	-2.2%	-15.7%	+22.8%	-32.2%	+22.2%	-29.7%

FABRIC SPECIFICATION

	SAMPLE NO	WIDTH Cm	COURSES 10Cm	WALES/ 10Cm	WEIGHT/ SQUARE M.	STITCH LENGTH
GREIGE FABRIC	3046	47.3	150	146	111	3
BLEACHING	340	43.5	144	163	109	2.9
MERCERISED- 10%	125	39.2	128	173	113	2.8
MERCERISED- 20%	315	39.3	131	180	111	2.8

PAPER 1: The Application of Cross-Linking Resins to Weft Knitted Fabrics.

INTRODUCTION

Traditionally the use of cross-linking resins has been limited to the finishing of woven cellulosic and cellulosic blend fabrics. The major objective of resin finishing woven fabric is to improve the crease-shedding properties of the fabrics.

This is not the case with weft knitted fabrics as the crease resistance and Elasticity are good. The usual performance limitation of knitted cotton is that is has poor wet dimensional stability and shape retention when compained with woven fabric. The application of resin finishes to knitted fabric can substantially improve the dimensional stability and shape retention of weft knitted garments.

PURE FINISHED FABRIC

FABRIC PROPERTIES	WOVEN	KNITTED
Crease shedding	Poor	Good
Dimensional stability.	Good	Poor
Shape retention	Good	Poor
Stretchability	Poor	Good

The limitation on obtaining a completely stable fabric is the resultant loss of strength and harshness of handle that would occur if a large amount of resin were applied.

A suitable compromise of properties can be achieved which should result in a reduction of length shrinkage by 40-45% and 30-35% in the width.

This improvement has both technical and economic advantages as it is achieved without an increase in the wales and courses and therefore the fabric weight per square metre.

Methods of application

The pad-dry-bake process is the only one of the three conventional cross-linking methods, the others being moist and wet cross-linking, that can be used when resin finishing knitted fabrics. This is due to their susceptibility to length wise tension and it is very important that the greatest care should be taken, during the application and fixation of the resin, to ensure that the fabric is in as relaxed a condition as possible.

To this end the shortest possible path length should be arranged between the plaited fabric in the wagon and the padding mangle. A simple two bowl mangle fitted with rubber covered bowls of 60-70 shore hardness will give a large area of contact and therefore a high expression. The synchronisation of the speed between the padding mangle and the stenter chain should be controlled by a well counter-balanced single compensating roller

The width and overfeed on the stenter should be set to allow the fabric to return as close as possible to the fully relaxed reference state in both length and width. The nearer this condition is achieved then the greater will be the improvement in dimensional stability.

> The relaxed reference state is achieved by submitting a sample of greige fabric to the following tests.
>
> A standard 60^{0}C wash, rinse and spin, followed by tumble drying until dry.
>
> A further four rinsing and tumble drying cycles making five cycles in all.
>
> This method has been developed by the the international institute for cotton in Manchester.

The addition of a radioactive beta gauge on the exit of the pin stenter will allow continuous monitoring of the fabric weight per unit area. This will enable overfeed adjustments to be made for each individual piece.

Finally from the above it is clear that only a flash cure process, were the drying and curing occur in one stenter pass, will give a suitable low tension process as conventional curing ovens have a high degree of length tension.

<u>Cross-linking agents</u>

As with most things the choice of cross-linking agent is usually a compromise between the various technical and economic factors. The most important criteria are enumerated below:-

(1) Improved dimensional stability.

(2) Minimum strength loss.

(3) Fast curing rate.

(4) No loss of fastness of dyed shades.

(5) Minimum affect on fabric handle.

(6) Good washing performance.

(7) Low formaldehyde release without afterwashing.

(8) Good chloring resistance (especially for the USA).

These factors are compared with the major chemical types of cross-linking agents that are available in table No.1 From this table it is clear that dihydroxydimethylolethylene urea gives the best balance of properties and that only if good chlorine resistance is required are the more expensive dimethylolpropylene urea types employed.

As stated earlier the prefered curing method is flash curing in one pass on the stenter as it ensures that the fabric is held under minimum tension. The temperature and time of curing is of the utmost importance as this has a major effect on the loss of bursting strength. If only one yarn fails then the whole knitted structure can disintegrate, which is not the case if one warp or weft yarn breaks in a comparable woven fabric. Therefore the quality and performance of the initial yarn is of the greatest importance.

Under optimum conditons this loss can be kept down to a realistic 20% but if the conditions go out of control this can increase to 40% which is totally unacceptable. One useful effect of the upsurge of interest in the mercerization of knitted fabric is the increased strength produced which overcomes the reduction caused by resination.

Catalysts and other additives.

A typical catalyst for the pad-dry-bake process is magnesium choloride. It's action can be speeded up to make it suitable for flash curing by the addition of ammonium chloride, but unfortuneatly the stability of the bath is questionable and small amounts of hydrochloric acid are produced which help to degrade the cotton.

A welcome addition to the catalyst systems have been the discovery of the beneficial results of adding a small quantity of sodium fluo-borate to magnesium chloride catalysts. With the addition, a faster curing rate can be achieved or more importantly the same curing rate at a low temperature.

A temperature reduction of 20^0C from 170^0C to 150^0C is normal and the resultant benefits of reduced strength loss accrue.

The bursting strength, fabric handle and sewability can also be improved by reducing the frictional resistance of the yarns. To this end additions of both polyethylene dispersions and non reactive polysiloxane emulsions can be made to the resination bath.

A suitable padding recipe for a knitted cotton outerwear fabric would comprise.

60 - 80g	DHDMEU Commercial 50% Solution.
20 g	POLYSILOXANE EMULSION.
20 - 30g	POLYETHYLENE DISPERSION.
6 - 8g	MAGNESIUM CHLORIDE.
0.5 -0.75g	SODIUM FLURO-BORATE.

Pick up 70-80% flash cure at 150^0C.

Silicone elastomers

Silicone elastomers are the latest generation of cross-linking permament finishes. They are dimethylpolysiloxanes with hydroxyl or amino and hydroxyl functional groups that combing with methylhydrogen polysiloxanes and catalysts to form highly resiliant finishes. They can be applied by padding or batch exhaustion techniques.

They produce a permament finish that greatly improves the shape retention and sewability whilst imparting a soft full handle.

In the context of this paper we will consider their use as additives to the resin finishing bath. The silicone elastomers reduce the loss of strength that occurs on resin finishing. This is partly because they cross-link directly with the amino-plast resin and therefore reduce the amount of bonding that occurs with the cellulose molecules. but also because they dramatically reduce the yarn friction in the knitted structure.

<u>CROSS - LINKING RESINS</u>

CHEMICAL TYPE	STRENGTH LOSS LOSS	AFFECT ON DYE FASTNESS	AFFECT ON FABRIC HANDLE	CURING CONDITION	CHLORINE RESISTANCE	SHELF LIFE	WASHING PERFORMANCE AT THE BOIL	FORMALDEHYDE RELEASE	PRICE
UREA-FORMALDEYDE	MODERATE	REDUCTION OF LIGHT FASTN-ESS OF SOME DIRECT DYES	FIRMER	CAN BE FLASH CURED	POOR	I YEAR	POOR	POOR	LOW
MELAMINE FORMALDEYDE	RELATIVELY LOW	REDUCTION OF LIGHT FASTN-ESS OF SOME DIRECT DYES	FIRMER	SEVERE	MODERATE	I YEAR	MODERATE	MODERATE	LOW
DIHYDROXYDIM-ETHYLOLETHYL-ENE UREA	LOW	NONE	SLIGHTLY FIRMER	CAN BE FLASH CURED	POOR	MORE THAN 3 YEARS	GOOD	GOOD	MODERATE
DIMETHYLOL PROPYLENE UREA	LOW	NONE	SLIGHTLY FIRMER	CAN BE FLASH CURED	EXCELLANT	MORE THAN 3 YEARS	EXCELLANT	GOOD	HIGH
DIMETHYL HYDROXYL POLYSILOXANES	NONE	NONE	SOFTER AND FULLER	MODERATE CURING CONDITIONS	EXCELLANT	I YEAR	GOOD	NONE	HIGH

TABLE NO.I

PAPER 2: The use of Viscous Foams as Textile Printing Thickeners

BACKGROUND

An investigation into the possible uses of stable foam as a textile printing thickener has been underway at the Shirley Institute for the last year. The likely advantages of such a process include

Reduced thickener costs (up to 90% saving)
Substantial energy savings.
Shorter or no washing off.

One initial objective was to see if it were possible to produce a foam printing paste that was sufficiently stable to stand and be used for one full eight hour shift period, as this would substantially reduce the capital outlay on foam generation equipment. The investigation has been split into two major parts that are proceeding concurrently.

1) To study the characterisation of stable foams in terms of blow ratio, viscosity, stability, bubble size and distribution.

2) The development of stable foam printing thickeners and the comparison against conventional printing thickeners based on natural gums or synthetic polyacrylate thickeners. After discussion with the major printers in the United Kingdom It was decided to concentrate on producing printing systems for reactive, vat and disperse dyestuffs and pigment colours.

THE CHARACTERISATION OF VISCUS FOAMS

Before the results of the work are discussed it is useful to give definitions of the parameters that are used to characterise foams.

BLOW RATIO

This is the ratio of the weight of a given volume of liquid prior to foaming to the weight of the same volume of foam. eg. A foam with a blow ratio of 5:1 will have a density of 200 g per litre of foam.

VISCOSITY

The viscosity of the foam can be measured with a rotary viscometer such as the brookfield RUDT used at the Institute. The flow properties of foams are comparable to that produced by Non-Newtonian fluids.

STABILITY AND HALF LIFE

This is usually defined as the time taken for half of the original liquid to be released by the foam by self drainage. For the foams used as printing thickeners this is not the case as even after twenty four hours their is no liquor drainage because of the inherent viscosity of the original liquid.

BUBBLE SIZE AND SIZE DISTRIBUTION

The bubble size and distribution effects the stability and viscosity properties of the foams. Fine foams with small spherical bubbles are more stable than foams with larger bubbles.

A method of photographing a sample of foam in a petri dish by illumination from beneath the foam has enabled prints to be developed of x 8 magnification from which bubble size and distribution can be measured.

Viscosity measurements have been made using a Brookfield RVDT viscometer of liquors and their resultant foams. The effect of pumping through a Graco air pump such as is used on Johannes Zimmer rotary screen printing machine has been examined and the change in viscosity, blow ratio and printability determined. Foam which has been stored in a two foot high column was investigated for gravitational changes in the foam from the top to the bottom of the column in respect of viscosity, Blow ratio and amount of dye present.

Film formers of various types, sodium alginate, sodium carboxy methyl cellulose and a carob gum derivative were added to a xanthan gum/sulphosuccinimate foaming liquor and the effects on blow ratio and printability of the resultant foam were examined. Bubble size varies according to the liquor formulation. Table 1 illustrates the differences in bubble size and distribution that occurs with time. The foam was from 5 g/1 of sulphosuccinimate foaming agent and 5 g/1 xanthan gum stabiliser.

TABLE 1

COMPARISON OF BUBBLE SIZE

	% of bubbles								
Bubble size (Diameter in microns)	129	258	387	516	645	774	903	1032	1161
Fresh	23	43	23	8	3				
After 1 hour		12	42	36	10				
After 2 hour		3	10	29	22	14	12	10	

There was no liquor drainage from these foams even after standing for 24 hours. But their is clearly changes in blow ratio and the shape of the bubbles

Two foams were prepared from the same liquor having different blow ratios, the bubble size and distribution of each foam were measured. (Seed Table 2).

TABLE 2

BUBBLE SIZE AT DIFFERENT BLOW RATIOS OF FOAMS PREPARED FROM SAME FORMULATION

Bubble size Diameter in microns	129	258	387	516	645	774	
Blow Ratio 5:1	4	76	20				% of bubbles
,, ,, 13:1	12	36	44	5	3		

These figures show that the higher blow ratio foam resultant in a wider spread of bubble size indicating a less stable foam. The most stable foams have very small spherical bubbles.

A foam prepared from 5 g/1 xanthan gum, 5 g/1 sulpho succinimate, 5 g/1 carob derivative and 25 g/1 Disperse Blue 148 was placed in a round column of 4 "diameter and 24" height. The foam was allowed to stand for 6 hrs. The column was separated and foam from the top, middle and bottom measured for blow ratio and viscosity. From the blow ratio the amount of dye in each area was calculated Table 4.

TABLE 4

VISCOSITY AND BLOW RATIO OF STANDING COLUMN OF FOAM

	TOP	MIDDLE	BOTTOM
Blow ratio	7.6	6.8	5.2
Viscosity (poise) Measured by brookfield at 10.0 rpm.	58	57	56
Wt of dye/litre of foam (g).	3.3	3.7	4.8

PRACTICAL PRINTING SYSTEMS

After discussions with the major printers in the United Kingdom, It was decided to develop printing systems for the four printing styles detailed below.

Vat dyestuffs on cotton by the two stage process.
Disperse dyestuffs on polyester.
Reactive dyestuffs on cotton.
Pigment colours on polyester/cotton.

The first bulk trial was carried out on a Johannes Zimmer rotary screen printing machine, Incorporating the rolling rod squeegee. A two colour design with both a fine line and a blotch laquer screen was used. The foam printing paste was generated into 50 litre tubs.

The print paste comprised
10 gl^{-1} xanthan gum.
5 gl^{-1} sulpho-succinimate foaming agent.
x gl^{-1} vat dye paste.
- water

Foamed to a 9:1 blow ratio on a cowie and riding foam generator. The print was produced at 30 metres per min. On a 60 square woven cotton. After drying the fabric was flash aged using a sodium hydroxide and sodium hydrosulphite reducing bath.

Some degree of flushing was evident as the graco air pump suplied the printing paste to the screen.

There was complete breakdown of the foam on passing through the screen and the resultant liquid had sufficient residual viscosity to ensure that there was good edge definition of both the fine line and the blotch screens. The push through of the print was very high and it was considered that the addition of a small quantity of a natural gum film former would reduce the push through and ensure that no rubbing problems would occur before fixation.

The subsequent bulk trial on vat dyes was conducted on a stork RD8 rotary screen printing machine. The stork company have developed a closed squeegee system comprising a leading and a trailing edge with an open duct for the foam. This open duct is kept under positive pressure by direct conection to the outlet of the foam generator.

Trials were conducted with both the open and the closed squeegee systems. The printing trial with the open squeegee started well but after 50 metres the print definition and colour strength started to decrease. On investigation it was found that the area of foam around the squeegee had substantially increased in blow ratio and as their was insufficient hydraulic pressure at the squeegee edge the print paste was not being forced through. This fault did not occur with the closed system so all the subsequent trials used closed squeegee.

The trials units pigment colours on the stork machine entailed changing the print paste compostion and the resultant pick up and colour yield.

The two print pastes consisted of

	1	2
Colour	$80gl^{-1}$	$80gl^{-1}$
Binder	$120gl^{-1}$	$200gl^{-1}$
Synthetic thickener	-	$40gl^{-1}$
Foaming agent	$5gl^{-1}$	$5gl^{-1}$
xanthan gum	$5gl^{-1}$	-

Both printing pastes had a blow ratio of approx 6.1 but with substantially different solids content. The wet pick-up of print paste No.1 was 18.5% for 100% cover and that for print paste No.2 was 36% for 100% cover. The colour yield is substantially higher for paste No.2 but there is only minimal differences in blotch cover or fine line definition. As the wet pick up is much lower than with conventional thickeners then substantially higher printing and drying speeds can be achieved. The final prints were fixed in dry heat for 3 minutes at 180^0C.

Initial trials were also carried out with disperse dyes on a weft knitted polyester fabric, using the following print paste recipes.

	1	2
Colour	$50gl^{-1}$	$50gl^{-1}$
Foaming agent	$5gl^{-1}$	$5gl^{-1}$
xanthan gum	$10gl^{-1}$	$10gl^{-1}$
High viscosity alginate		$10gl^{-1}$

The blow ratio was again 6.1 and the prints were fixed at 170^{0}C for 5 minutes in a high temperature steamer

The prints showed good blotch coverage but only moderate fine line definition. The addition of the high viscosity alginate caused a substantial increase in colour yield. Further trials using a larger volume of a high solids content low viscosity alginate are being arranged.