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STRENGTHENING OF THE CHINA DYEING AND FINISHING DEVELOPMENT CENTRE

DG/CPR/87/017/11-02

CHINA

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Technical report:	Visit of expert in cotton and polyester/cotton preparation*

3.1

Prepared for the Government of the People's Republic of China
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of Kenneth Dickinson,
Expert in cotton and polyester/cotton preparation

Unido 1988 V.P.

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United Nations Industrial Development Organization
Vienna

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* This document has not been edited.

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EXCHANGE RATES

DURING THE PERIOD OF THIS MISSION 1-30 JUNE THE FOLLOWING EXCHANGE RATES PREVAILED:

US $1 = RMB¥ 3.7

UK £1 = RMB¥ 6.7 - 6.4

ABSTRACT

Strengthening of the China Dyeing and Finishing Development Centre project DG/CPR/86/056/11-02/31.7B

Technical Report - Visit of Expert in cotton and polyester-cotton preparation. June 1988

The report details the activities of the expert on cotton and polyester-cotton preparation with the China Dyeing and Finishing Development Centre. June 4-24 1988.

Visits were made to seven Shanghai mills. A three day Seminar covered theoretical and practical aspects of fabric preparation. The facilities and future development work of the CDFDC were reviewed.

The main recommendations are that the CDFDC should continue to give priority to their development work on preparation auxiliaries and process assessment and that industrial investment in the short term should be directed to open-width preparation.

I. INTRODUCTION

The visits by five experts in textile processing are planned as part of the UNIDO project - The strengthening of the China Dyeing and Finishing Development Centre (CDFDC).

The first of these visits by an expert in cotton and polyester/cotton preparation in June 1988 is covered by this report.

The duties of the expert were agreed by Dr G.W. Madaras (C.T.A.) and Mr Zhou (Vice-Director CDFDC) during the visit by Dr Madaras to CDFDC early in 1988. These are:

1) Survey the technical level of desizing, scouring, bleaching and mercerising in some representative dyeing and printing factories.

2) Review research work conducted in the field of preparation of cotton and cotton/polyester fabrics and advise on the research programme in this field at the CDFDC.

3) Give technical advice on problem solving in research and application: advise on production problems in scouring, bleaching and mercerising.

4) Conduct a seminar for research workers and high level technical personnel from factories on the theory and practice of preparation processes.

It was possible to cover these areas in a detailed programme agreed with CDFDC personnel at the start of the visit. The various duties are covered in the report of the activities of the expert during his time in Shanghai during June 1988.

II. RECOMMENDATIONS

On the basis of production and research facilities seen by the expert and on discussions with CDFDC and mill personnel, the following recommendations are made:

1) Additional laboratory equipment, as detailed in Section III C should be obtained by CDFDC.

2) CDFDC should continue to give emphasis to the areas in which they have started to work, ie: preparation auxiliary product evaluation and assessment of one and two stage preparation routes.

3) There is a role for CDFDC to use laboratory and/or pilot plant facilities to obtain information of use to individual mills in the selection of equipment to meet their needs.

4) Labour and water costs should be monitored since increases will influence future processing options.

5) In the immediate future, any industrial investment for rope processing should be limited to low tension washing machines.

6) New industrial investment should be in open-width continuous preparation, preferably including combi-steamers.

7) Some industrial investment is required to improve chemical application when mercerising heavy weight or other fabrics, not easily processed in present equipment.

III ACTIVITIES

IIIA Fabric preparation in Shanghai mills

The following mills, representative of the dyeing and finishing industry in Shanghai, were visited:

6.6.88 Shanghai No 2 Dyeing and Printing Mill
7.6.88 Ding Xin Dyeing and Printing Mill
Yong Xin Raincoat Weaving and Dyeing Works
8.6.88 Xin Yin Printing and Dyeing Factory
Shanghai No 20 Bleaching Factory
9.6.88 Shanghai Knitting Factory
11.6.88 Shanghai No 3 Printing and Dyeing Works.

Details of these visits are given in Appendix 2. In all visits the expert was accompanied by 3 or 4 CDFDC personnel.

In all the mills production is directed primarily to export markets and the general standard of finished goods is that required by these markets.

Almost all 100% cotton fabrics are prepared in rope form using conventional caustic soda scour followed by hypochlorite bleaching. Prior to scouring any desizing generally used waste caustic liquors. Some improvement in desizing may be possible by adding oxidants at this stage (oxidative desizing).

The basic preparation route of caustic scouring in kiers followed by hypochlorite bleaching in pits was that in use in Europe 60 years ago when some of the Shanghai mills were established. The volume of fabric processed in China has justified some replacement of batch kier by continuous J box processing. Hypochlorite bleaching pits are replaced mainly by scrays, holding fabric about 30 minutes at ambient temperature, these operating to give continuous production.

In the USA, for rope processing, hypochlorite bleaching has generally been replaced by peroxide bleaching in J boxes. In Europe many kiers were converted to use peroxide in combined scour/bleach processes. These changes were much influenced by significant increases in labour costs; savings in these more than offset increased chemical costs. The absence of these changes in China must in part be due to the low labour costs. Some detail of this is given in Appendix 3. Replacement of hypochlorite could be justified in the future in the event of significant increases in labour, water or energy costs.

The kier and J box systems are satisfactory for all but very heavy weight fabrics, particularly as a high proportion of goods are mercerised. Some benefit in quality could be obtained by installing low tension rope washers - (Tensitrol type). In the short term this is the only area where investment in rope processing is advised. Any consideration of further changes from kier to J box processing must be balanced against the advantages of investing in open-width equipment.

Most polyester-cotton blends are being processed in open-width. The preparation ranges seen in Shanghai use conveyor steamers, the type of equipment used initially in the USA for open width preparation. Production volume in China justifies fully continuous processing as opposed to pad-batch systems which proved economic in Europe when polyester-cotton fabrics were introduced. None of the mills have installed the roller bed or combi-steamer now favoured in Europe, though I understand one Menzel machine is installed in Shanghai No 4 mill.

Typically USA practice of caustic scour followed by peroxide bleach is used for preparing polyester-cotton. As in rope processing, desizing is usually with waste caustic liquors and there is scope for evaluating oxidative desizing and combined scour/bleach systems.

The maximum width of polyester-cotton seen was 1.75m. This is less than now processed elsewhere. Future export demands could require wider fabrics. This should be considered in respect to investment in weaving and preparation equipment. As indicated above, future investment in preparation ranges should be based on combi-steamers. These provide inital fabric heating in a tight strand section before plaiting onto a roller bed, advantageous for both polyester-cotton and heavier 100% cottons. As indicated in the costings, savings in equipment costs are possible if minimum stage processing can be used.

One mill operated a three stage process, caustic scour-chlorite bleach-peroxide bleach, to obtain very high whiteness on polyester-cotton. Chlorite replacement on grounds of cost, corrosion and environmental considerations warrants examination.

Interest was shown at the mills, and in the seminars, in cold pad-batch bleaching. This provides low cost preparation. Batch storage requirements limit this process to mills with adequate space for holding fabric on A frames for several hours. The process could also have application for small volume special fabrics.

Steam costs depend on possible availability of low cost steam to the mill or fuel costs for on site generation. Heat recovery systems are in use but where costs remain high an energy audit could be beneficial.

Most mills mercerise a high proportion of their production. No problems are seen in this area other than for certain fabrics which are difficult to penetrate with strong caustic liquor. This is an area warranting investment, eg in vacuum impregnation.

One company operated an ammonia vapour phase treatment, indicating that in some areas the preparation/finishing processing in China is well advanced in the use of modern technology.

Mill tours included dyeing, printing and finishing departments. Few problems were identified as originating in preparation but experts in these areas are better able to comment on equipment and may identify problem areas during their visits.

Modern laboratory equipment, mainly for colour match prediction and physical testing of finished fabrics, was seen in several mills. Management personnel were keen to discuss modern technology and drew attention to new requirements aswell as preparation of cotton-wool, cotton-linen, cotton-ramie blends.

Following each mill tour there was discussion with senior mill management and engineers. Some of the questions raised are mentioned above, ie replacing chlorite. Other subjects of interest to several mills were: peroxide bleach stabilisers, desizing problems due to polyvinyl alcohol or paraffin wax redeposition and bleaching various fibre blends.

Many of these questions were discussed further at the seminars. Some will be studied in future CDFDC work.

IIIB Seminars

CDFDC had planned for seminars to be held for 3 days 13-15 June. These were attended by 51 people, 18 from mills in the Shanghai area, 14 from mills in other provinces, 9 from academic establishments and 12 from STRI & CDFDC.

The seminars covered the following areas:

Monday	June 13	am	Fabric preparation - introduction
		pm	Hydrogen peroxide - process control
Tuesday	June 14	am	Stabilising hydrogen peroxide bleaching systems
		pm	Desizing (Including oxidative processes)
Wednesday	June 15	am	Cold Pad-Batch Bleaching
			Modern continuous processing
		pm	Mercerisation

Most of the final session was an open discussion covering many questions, some raised previously by individual Shanghai mills

An additional meeting for some STRI and CDFDC staff was held on Thursday June 16 to review laboratory proceedures and introduce central rotatable plan (C.R.P.) designed experimental programmes.

The seminars proved to be a very important part of the experts programme.

The papers are being translated by CDFDC for wider circulation. Summaries of the papers are given in Appendix 4.

Participants' Units

(1) Shanghai region

1.	Shanghai No 2 Dyeing and Printing Mill	2
2.	Shanghai No 3 Dyeing and Printing Mill	1
3.	Shanghai No 4 Bleaching and Dyeing Mill	1
4.	Shanghai No 5 Dyeing and Printing Mill	1
5.	Xinfeng Dyeing and Printing Mill	1
6.	Dingxin Dyeing and Printing Mill	1
7.	Shanghai No 10 Dyeing and Printing Mill	1
8.	Xinguang Underwear Weaving and Dyeing Mill	1
9.	Yongxin Raincoat Weaving and Dyeing Mill	1
10.	Guanghua Bleaching and Dyeing Mill	1
11.	Yuantong Bleaching and Dyeing Mill	1
12.	Shanghai No 17 Bleaching and Dyeing Mill	1
13.	Shanghai No 21 Bleaching and Dyeing Mill	2
14.	Shanghai No 26 Bleaching and Dyeing Mill	1
15.	Gaonan Dyeing and Printing Mill	1
16.	Shanghai Knitting Mill	1
17.	China Textile University	1
18.	Shanghai Textile Research Institute	3
19.	Shanghai Dyeing and Finishing Technical College	2
20.	Shanghai Dyeing and Printing Corp.	1
21.	China Dyeing and Printing Information Centre	2
22.	China Dyeing and Finishing Development Centre	9

(2) The Provinces

1.	Tianjin Dyeing and Printing Mill (Hebei Prov)	1
2.	Wuxi Dyeing and Printing Mill (Jiangsu Prov)	1
3.	Changzhou Dongfeng Dyeing and Printing Mill (Jiangsu Prov)	1

4.	Nantong No 1 Dyeing and Printing Mill (Jiangsu Prov)	1
5.	Kunshan Dyeing and Printing Mill (Jiangsu Prov)	1
6.	Jiang Yin Dyeing and Printing Mill (Jiangsu Prov)	1
7.	Changshu Dyeing and Printing Mill (Jiangsu Prov)	1
8.	Xuzhou Dyeing and Printing Mill (Jiangsu Prov)	1
9.	Anhui Dyeing and Printing Mill (Anhui Prov)	1
10.	Jinan No 2 Dyeing and Printing Mill (Shandong Prov)	1
11.	Qindao Dyeing and Printing Mill (Shandong Prov)	1
12.	Wuhan Dyeing and Printing Mill (Hubei Prov)	1
13.	Shijiazhuang No 1 Dyeing and Printing Mill (Hebei Prov)	1
14.	Tangshan Dyeing and Printing Mill (Hebei Prov)	1
15.	Changzhou Dyeing and Printing Research Institute - (Jiangsu Prov)	2
16.	Changzhou Chemical Research Institute (Jiangsu Prov)	1

The total amount: 38 units
53 participants

China Dyeing and Finishing
Development Centre

IIIC The China Dyeing and Finishing Development Centre

(laboratory facilities and experimental work)

CDFDC relies on the laboratory facilities of STRI. The institute is well equipped for analytical work with many modern instrumental methods available. There is also equipment for evaluating some dyeing and finishing processes. The STRI library subscribes to many textile journals, several of which contain papers relating to fabric preparation.

The location of the dyeing and finishing equipment is not ideal for fabric preparation work, there being some distance between laboratories for preparing chemical solutions, application by pad mangle, heating etc.

It was agreed that the expert should carry out some laboratory work with STRI/CDFDC personnel. That planned by the expert was designed to demonstrate laboratory techniques to simulate pad-steam processing. This included preparation of scour and bleach liquor, determination of liquor pick up,"steaming", analysis of residual peroxide quantitatively and qualitatively. Practical tests on polyester-cotton fabric from Shanghai No2 mill were preliminary ones to asses brightness possible without chlorite bleaching.

Long liquor and cold pad-batch bleaching tests were carried out on wool-cotton blend fabric from Xin Yin mill, these serving as preliminary work on the problem of bleaching and removing cotton seed with minimum damage to wool.

The principles of Central rotatable plan (C.R.P.) experimental designs were explained with preliminary tests being made to compare two non-silicate bleaching stabilisers.

The importance of fluidity (D P) testing for cellulosic fabric degradation was reviewed. Details of a rapid method applicable for polyester-cotton blends are to be supplied. Spot tests for localised

cellulose damage and other tests detailed in the Interox Bleachers Handbook were considered.

The objective in the above work, to ensure a basic understanding of laboratory preparation methods and evaluation, was achieved.

To carry out such work more effectively CDFDC require additional equipment:

1) Laboratory steamer eg. Benz, Werner Mathis.

2) If the above cannot be sited near to existing pad mangle, consider purchase of a smaller pad mangle suitable for use in conjunction with the laboratory steamer.

3) Pending availability of a laboratory steamer, purchase polythene bags able to withstand use in oven at 100°C.

4) Make available a 10 -15 l capacity hot water boiler to provide ready supply of hot water for rinsing after scouring and/or bleaching tests.

5) Mettler type direct reading balance 0-200gm or 0-500gm to facilitate weighing of fabric samples and preparation of chemical stock solutions.

6) Equipment for fluidity test, including rapid fluidity testing.

7) Small sample dyeing/bleaching equipment for long liquor test eg: Pegg Barrow or Jeffries type.

8) Supply of standard fabrics 100% cotton and polyester/cotton preferably known to be moderately difficult to bleach ie. to clear cotton seed residues.

IIID Future CDFDC work

Senior CDFDC staff have considerable mill management experience which will be valuable for on going contacts with the textile industry, development of research programmes and transfer of laboratory results to pilot plant and mill production.

To date, less work has been done by CDFDC in the area of fabric preparation than in some other areas, eg fabric coating, flame retardants.

The work which they have started, on the development of auxiliary products, warrants priority, particularly to gain product information about chemicals available in China. Peroxide bleach stabiliser evaluation is very important since products satisfactory under particular conditions, eg long liquor bleaching, may be less effective in another, eg continuous bleaching.

Stabiliser evaluation is important also in their work on the comparison of one and two batch preparation systems. This work should also consider oxidative desizing, particularly as alkali alone is used in many mills.

Industrial interest in linen, and ramie and other blends, eg cotton-wool, warrants CDFDC evaluation work.

The STRI work on "mercerisation" effects could lead to CDFDC work to relate this to production process possibilities. The CDFDC should also note any new information published about "hot-mercerisation".

The paper by Dr. J.G. Roberts on Energy Audits should be studied and consideration given to whether or not a similar audit might be carried out in conjunction with a Shanghai mill.

Metal contamination, particularly iron, is a known potential hazard when bleaching with hydrogen peroxide. It has been overcome in several countries by attention to process control, use of "extraction" scour processes and sequestrant selection for bleaching auxiliaries. As the CDFDC evaluation on one or two batch processing develops, some attention to this potential problem may be required.

Pilot plant equipment requirement for pad-steam scouring and/or bleaching was discussed with the recommendation that equipment should be capable of providing a range of fabric retention times, if necessary by varying running speed and length of fabric in the steamer. A minimum running speed, possibly about 20 m/min, will be necessary to provide some mechanical action, particularly during washing off.

IV CONCLUSIONS

CDFDC can play an important role in assessing the applicability of new preparation methods, eg oxidative desizing, minimum stage processing, in China having regard particularly to local labour, water and energy costs and availability of surfactants and sequestrants. Priority should be given to their work on auxiliary product evaluation.

Careful consideration is required in selection of equipment appropriate for a pilot plant if this is to be an effective intermediate evaluation stage between laboratory and mill production.

In industry the continued use of caustic-scour followed by hypochlorite bleaching for rope preparation of 100% cotton fabrics appears justified because of present day labour and water costs. When these increase significantly assessment of peroxide based bleaching methods, used in Europe and U.S.A. will be warranted. Further investment in rope processing should be limited to improving washing machines.

Existing open width equipment is generally operating at lower speeds than more modern equipment. Future investment should be directed to open width, rather than rope processing,preferably for combi-steamers capable of higher running speeds and processing wider fabrics.

ACKNOWLEDGEMENTS

The expert thanks the staff of CDFDC and STRI for making most efficient arrangements for mill visits, the seminars and translation facilities.

Throughout the visit every assistance was given to the expert.

Thanks are expressed also to Interox Chemicals for technical literature and the loan of materials to use in seminar presentations.

LIST OF PEOPLE MET DURING MISSION

BEIJING

Zhu Xing	Dept of Foreign Affairs MTI
Caterina Benardelli	Programme Officer UNIDO

SHANGHAI

Ding Li	Shanghai Textile Industry Bureau
Ms Dai Shuqing	Deputy President STRI
Zhou Wei-Tao	Vice Director CDFDC
Cheng Cheng-Kang	Director Project Planning CDFDC
Xu Ninglun	Head of Pilot Plant CDFDC
Cai Pei-Wei	CDFDC
Shao Xinzhou	Director Dyeing and Finishing STRI
Madame Zhu	CDFDC

Personnel met during mill visits are given with individual visit reports (Appendix 2).

INDIVIDUAL MILL VISITS

(1) 6.6.88 Shanghai No 2 Dyeing and Printing Mill

The Mill

Personnel Fang Cai Xin Vice Director
Yao Ming Hua Director Assistant
Liu Zhi Lu Vice Chief Technological Section

The mill employs 2400, 80% directly in production work (three shifts).
In 1987 95 million m^2 fabric, (61 million m) was processed, finished product mainly exported to U.S.A.
Mill produces bleached white, dyed and printed fabrics.

Processes

100% cotton (mainly 2.25m width)

Singe
Quench in dilute caustic soda
Wash
Acid desize
Wash
Pressure Kier
Wash
Hypochlorite bleach 30 min J box
Wash

Polyester/Cotton (up to 1m width) 3 ranges running 65m/min.

Alkaline desize, 45min, roller bed steamer
Wash
Chlorite bleach, 90min, roller batch steamer
Wash
Mercerise
Peroxide bleach R box. Organic stabiliser.

For dyeing and printing the chlorite stage is omitted. Prepared fabric finished white or goes forward to three dyeing (3 production lines) or roller printing (5 machines). Post bleaching equipment includes Morrison ammonia treatment.

Discussion

The morning mill visit was followed in the afternoon by an open forum discussion attended by about thirty engineers, most concerned with fabric preparation.

General comment was made by the expert about current processing and possible alternatives.

The rope process might be shortened by using a one stage scour/peroxide bleach but as the existing route uses a continuous hypochlorite bleach the economics re water and energy saving require evaluation.
If the current volume of 100% cotton is maintained and rope processing is acceptable, Kier replacement is likely to require a J box preparation route.

Open width modification should consider wider width capability and combi-steamer processing (30-45 minute steaming).

Mill personnel questions indicated the following concerns:-
(1) Full white on polyester-cotton blends had only been possible by two stage chlorite/peroxide processing.

The writer commented that only chlorite could bleach the polyester component but that in U.S.A. and Europe generally acceptable whiteness was obtainable by peroxide alone. Factors which could be considered are:-
tonal differences chlorite c.f. peroxide bleach might require alternative optical brightening agent.
"Extraction", sequestrant additives to caustic scour could reduce metal content, especially iron.
Optimisation of peroxide bleach system, possibly using silicate with organic stabiliser.

(2) Concern about metal contamination, limiting levels of peroxide for bleaching.

This is another area where sequestrant use, in scour and/or peroxide can assist but the problem of high localised, particulate contamination is not yet resolved.

(3) Processing heavy weight 100% cotton in open width.

For this, combi-steamers, with tight strand section prior to roller bed should be considered.

(4) Processing linen/cotton and ramie/cotton.

A chlorite stage is usually required for high whites. If woody matter is present, long liquor chlorination may be necessary.

(5) Processing 80 cotton/20 silk and 80 cotton/20 wool mixtures.

Problems were discussed and the approach of minimum alkalinity and acceptance of lower white indicated. Interest in cotton/silk blend is high in Japan.

(6) Value of "shock" processes

One advantage of short steaming 1-2 min was capital cost but a disadvantage is the washing machine capacity required to remove high caustic levels. In Europe the more flexible use of roller bed steamers (20-40 minute steaming) is now preferred.

(7) Prevention of silicate deposition.

Inherent problems associated with silicate are minimised by using auxiliary products which inhibit silicate crystallisation/precipitation, the "extraction" approach in alkaline pretreatment particularly to reduce calcium content.

(8) Removal of parrafin wax lubricants.

Normal scouring needs supplementing by use of surfactants, generally non-ionic with short ethylene oxide chain/anionic blends. In U.S.A. use of white spirit (varsol) has been practiced as an additive to the process liquors.

(2) 7.6.88 Ding Xin Dyeing and Printing Mill

The Mill

Personnel Xu Hei Hao Director
Hua Zi Mei Director scouring and Bleaching
Li Jiao Me Director Technical Dept.
We Jiao Ren

The mill employs 1000, producing 30 million m/year, max width 1.6m. It processes 100% cotton and polyester/cotton blends, about 50% being pigment printed. Finished product is mainly exported.

Processes

Two preparation ranges running at 100m/min.

Singe
Quench
Wash
Caustic scour R box. 1 hour retention, wet bottom.
Wash (horizontal washes)
Peroxide bleach R box. Silicate stabiliser, "dry" bottom.
Wash

Prepared polyester/cotton goes forward to heat setting.

Discussion

The visit was followed by discussion which included the following points raised by mill personnel.

(1) Chemical Feed.
Details of systems used in Europe were described i.e. Rotameters, Metering Pumps, Texicon, Polymetron.

(2) Some spare capacity for two vertical washer exists. Could alternative uses be suggested.
Limited retention time makes this unlikely.

(3) P.V. alcohol redeposition. Problems experienced. Recommended that an oxidant be used in the alkaline scour to promote p.v. alcohol degradation.

(4) Silicate deposition. Orthosilicate has been tried and gave some improvement.
Calcium from fabric or water supply can aggravate silicate precipitation so consider use of sequestrants in caustic scour. Consider replacement of silicate by organic stabiliser.

(5) Any advantage in using "wet-bottom" of second R box (peroxide stage).
Only advantage could be pre wash off effect but overall likely to lead to less efficient use of H_2O_2.

(6) Recommendations for linen and linen/cotton blends.
The Mill could require to introduce a chlorite stage, possibly pad-batch but processing will depend on linen quality to required standard.
Some additional literature will be left with CDFDC.

(7) Rayon bleaching - difficulty in bleaching to full white. General guidance to use mild conditions, also to check on whether or not the rayon requires a desulphurising treatment in longer liquor as previous.

(8) Cotton/wool bleaching
Requires mild conditions. Mill could consider a cold pad.

(9) Cotton/wool spinning.
Problem of blending low wool with shorter cotton staple fibres.
No definite advise given but information will be sought.

(3) 7.6.88 Shanghai Yong Xin Raincoat Weaving and Dyeing Works

The Mill

Personnel Ma Yong Factory Director
Qiu Yi Ren Technical Department Manager

Shanghai Yong Xin Raincoat Weaving and Dyeing Works employs 2300, turn over 200 million RMB/year
Production is 50 million metre/year (appeared to be mainly in 1m width) rainwear fabrics with some trend towards lighter weight fabrics. Production is mainly polyester/cotton blends.

Process

Range runs at 80m/min.

Singe
Quench in 4-5 g/l NaOH
Batch auto roll and hold approx 3 hours
Wash off
NaOH scour 45 min in conveyor steamer
Wash off (5 vertical washers)
Peroxide bleach 45 min in conveyor steamer using a mixed silicate/organic stabiliser (developed by the mill).

A second line has three conveyor steamer units operating
NaOH scour - peroxide bleach - peroxide bleach.
There are two mercerisers.
Prepared fabric is mainly pad dyed solid shades, dispersed/vat or dispersed/reactive.

Discussion

(1) The conveyor steamers were installed only three years ago and were selected as best option, in their opinion, to handle the heavy weight raincoat fabrics.

(2) A problem concerning creasing is being met as the mill seeks to process lighter weight fabrics. Creasing occurs in first wash boxes after desize. Possibility of assessing batching into trucks (plaiting) after quench could be considered as fault might be developing in rolled batch. Another possibility is varying size swelling/degradation and the addition of an oxidant to quench liquor should be considered.

(3) Dye resists.
There may be (a) residual, unevenly redeposited wax
(b) silicate redeposition
(c) local overbleaching

Mill should consider adding a detergent type surfactant to desize or caustic scour. It should be possible to confirm that residual wax is a problem by solvent extracting faulty fabric sample and redyeing. Silicate deposition unlikely if the silicate/organic stabiliser blend is effective. Local overbleaching can be identified if other possible causes are eliminated.

(4) 8.6.88 Xin Yin Printing and Dyeing Factory

The Mill

Personnel Yin Yung Sung Vice Director
with managers of preparation and dyeing departments.

Xin Yin Printing and Dyeing Factory is a new mill opened two years ago, part still being constructed, which employs 800 staff.

Current production is 20 million m/yr and when completed the mill will produce 40 million m/year.

It produces a wide range of fabrics, up to 1.75m wide, 100% cotton or cotton/polyester blend, about equal amounts of each. Finished goods, some made up to sheets, shirts etc, are mainly exported.

Processes

There are two preparation lines but as the gas supply to the mill is limited only one line can be operated at a time.

100% cotton fabrics :

Singe (a saturator/quench is installed but was not in use)
Alkali desize 10g/l NaOH applied in
Rope saturator before
J box 40 min
Wash
Re saturate with alkali
Kier boil 4 hour 1.5 Atm.
Wash
Two stage J for hypochlorite
Wash
Sour
Wash

Polyester/Cotton blends

A three stage open width conveyor steamer system is installed, only two being used for polyester-cotton with caustic scour followed by peroxide, both 1 hour retention, running 55-60 m/min.

After bleaching fabric is heat set and mercerised or vice-versa depending on quality.

Dyeing is by dispersed/reactive dyes, three lines being available.

Other finishing machinery included those for Raising, Schreiner Finish and compressive shrinkage.

Discussion

(1) Silicate stabilisation for peroxide bleach was used initially but replaced completely by an organic stabiliser manufactured in China.

(2) The mill wishes to process a cotton 80/wool 20 blend and requested advice.
A cold pad process is likely to be the best approach and fabric sample was provided for tests by CDFDC.

(3) The mill has some dyeing problems which will be discussed with the dyeing technical adviser in due time. One problem on 100% cotton relates to white resist marks. These may be due to incomplete removal and/or redeposition of wax lubricants even with the double alkaline desize and scouring. Use of suitable surfactants might overcome this if it is the cause of faulty dyeing.

(4) Heavy, tight construction fabrics give problems in mercerising due to incomplete penetration of the strong caustic liquor.
The mill was advised to consider vacuum impregnation.

(5) The rope-form process is a lengthy one with corresponding high water use. The mill could consider a scour/bleach with hydrogen peroxide in the kiers, eliminating the hypochlorite stage, though as at other mills the economics of this often requires further evaluation.

(5) 8.6.88 Shanghai No 20 Bleaching Factory

The Mill

Personnel Niu De Shun Factory Manager
with preparation department manager.

The Mill

This is an older mill employing 550. Production is all bleached fabric, 40 million m /yr. In recent times the mill has moved from processing only low-medium quality fabrics to higher grades. 70% production is exported including interlining fabrics.

Processes

Preparation of 100% cotton is by caustic soda scour (kier) followed by hypochlorite bleaching. A two pass hypochlorite system is used with intermediate storage in pits.

After bleaching fabrics may be whitened only and dried or raised and coated.

Polyester/cotton blend fabric preparation is by hypochlorite pretreatment, mercerisation and peroxide bleach in a conveyor (not working at time of visit). Bleaching is followed by heat setting, whitening and fabric shrinking.

Discussion

The main problem of this mill is shade variation length wise in a single kier run. It was suggested that this could be due to uneven treatment in the kier, build up of impurities in the washer after kiering or inadequate control of hypochlorite application. Measurement of these parameters through a production run was recommended.

(6) 9.6.88 Shanghai Knitting Factory

The Mill

Personnel Cai Guanxiang General Manager
Diao Li Zhong Manager preparation and dyeing
with six managers/technicians

The Shanghai Knitting Factory was established in 1920 and is currently in process of modernisation. It employs 1800 in knitting, preparation and dyeing and making up departments.

There are 60 weft knitting machines producing a range of 100% cotton and polyester/cotton tubular knit fabrics, most of which is made up in garments, 14 million being produced annually, mainly for export.

58 warp knitting machines produce 1000 T/a fabric.

The preparation range for weft knit fabrics is traditional rope preparation with :

Hot Wash
Saturate 15g/l NaOH
J box 2 x 1 hour or Kier boil
Wash
Double application hypochlorite with 30 min in J
Wash, Sour, Wash.

Some fabric is further winch bleached for 40-60 mins depending on quality with 1 g/l hydrogen peroxide silicate stabiliser with simultaneous application of o.b.a. and blueing.

After preparation weft knit and warp knit fabrics may be dyed on winch or pressure jets. Beam dyeing is used for vat dyes on weft knit fabrics.

Discussion

(1) The mill modernisation includes a new building for preparation of weft knit fabrics. The first discussion was an outline of modern options for continuous processing. J box or open width with possibility of combined scour/bleach for both systems.

Kiers can be considered but the main trend is for open width conveyor steamers with about 30 mins retention. Appropriate fabric guides are fitted to ensure even chemical application.

(2) Stabilisers

General discussion of alternatives to silicate.

(3) Mercerisation.

The mill propose to mercerise part of their weft knit production. Equipment was discussed and a review paper provided (J S D C Oct 1987 pg 342)

(4) Cold Bleach

Knitted cotton fabrics can be cold bleached but these processes require long retention times, consequently large storage area for high volume production.

(5) Maintaining fabric elasticity.

Two aspects were considered (a) mechanical - at all times process with minimum tension, eg. pad-steam bleach on conveyor, sieve drum relaxed washing. (b) chemical - avoid use of silicate and use softener if required.

(6) Silk processing.

Suggested that degumming will require winch but care to avoid excess friction eg. use long liquor ratio. Bleach with mild peroxide.

(7) Ramie bleaching.

Limited direct advice, processing will much depend on pretreatments to degree of whiteness required.

(7) 11.6.88. Shanghai No 3 Printing and Dyeing Works

The Mill

Personnel	Fang Zhongmeng	Director
	Yang Zhangfang	Vice Director
	Jin Renzhong	Senior Engineer (Manager)

Shanghai No 3 Printing and Dyeing Works originated over sixty years ago as a Mill established by Calico Printers Association (Great Britain). During the Japanese occupation it was stripped of most of its machinery, reopened in 1954 before being handed over the Chinese Government in 1956. Modernisation commenced 1973. The total production of the mill, 70-80 million m, is designated for export, especially Australia and U.S.A., but to more than 70 countries. It employs over 2000, approx 200 being in the preparation section. Other sections are dyeing, roller printing, screen printing, finishing, packaging, roller engraving/screen preparation, and engineering.

Many types of fabric up to 1.4m width are processed, the mill being particularly noted for sateen and down proof fabrics.

It is set up to process small runs, as little as 3000m in 5 colour ways, by screen printing or 8000 m for roller printing. The mill processes only 100% cotton and a little 100% polyester knit goods, no cotton-polyester blend fabrics.

There are three preparation ranges

(1) Continuous rope J
Singe
Quench in dilute alkali
Store in pits 3-4 hour
2 J boxes, 45 min retention in each
Wash
Hypochlorite in J (ambient) ½ hour
Wash
Sour
Wash

(2) Kier
3 tonne capacity kiers operate with caustic scour followed by hypochlorite bleach.
Choice of Kier or J box route depends on fabric quality.

(3) Open width Kuster PKS type bleach (installed 1986).
Quench in 3-5g/l caustic soda
Steam 20 min on small conveyor steamer
Apply alkaline peroxide with Lastabil stabiliser (Hoechst)
Pass through under water chamber
Approx. 20 min at 60°C
Tight strand steamer 2 minutes without further peroxide addition.

This machine has been found to have limitations re developing absorbancy. This could be improved by using special surfactants but chemical processing cost is already high.

Subsequent to the visit, a proposal for a letter to Mr Jin was left with CDFDC in which it was suggested that the mill might make more efficient use of hydrogen peroxide by changing the process sequence to:

Caustic Scour Quench in tight strand section
Under water scour
Peroxide bleach 20 min in conveyor steamer

After preparation most fabrics pass forward to mercerising prior to dyeing, roller printing (4 machines) or roller printing (3 Stork machines) or dyeing. There is a range of dyeing machinery including continuous range, jigi,winch and jet. A Jumbo jig is about to be installed.

Finishing machinery includes calendars, Schreiner finish, embossing, preshrinkage, coating and resin application.

The labs are well equipped with apparatus for colour match prediction work (Macbeth) and physical testing of fabrics, eg strength, air permeability, abrasion resistance etc. Fluidity (DP) tests have to be sent for outside testing.

Discussion

The mill is producing high standard finished goods. The rope processing equipment would benefit from installation of low tension washers. The mill has some heat recovery but no water re-use facilities.

The disadvantages of the PKS type range are known and any further investment in open width processing should be directed to combi-steamers.

The possibility of batch pretreatment was discussed but space limitations are likely to preclude this approach.

Though an informative visit, in the preparation area there were no particular problems to warrant detailed discussion. The mill experiences some shortage of grey fabric and chemicals, this limiting production rather than technical matters.

APPENDIX 3 -1 -

PROCESS COSTINGS

Cost comparisons have been made for two areas. These serve to indicate the different importance of various factors between U.K. and China.

As a basis for these comparisons the following chemical and service costs have been used:

	China	U.K.	U.K. converted to RMB (1)
Caustic soda	0.536 RMB/kg	14.9p/kg	0.97
Sodium silicate	0.36 RMB/kg	12.0p/kg	0.28
Organic stabiliser	2.5 RMB/kg	70.0p/kg	4.55
Hydrogen peroxide 30%	2.16 RMB/kg		
equivalent to 35%	2.52 RMB/kg	35.0p/kg	2.28
Hypochlorite	0.16 RMB/kg	6.0p/kg	0.39
Wetting agent (2)	0.40 RMB/kg	100.0p/kg	6.5
Wetting agent (3)	1.76 RMB/kg	65 p/kg	4.23
Soda Ash	0.25 RMB/kg	6.0p/kg	0.39
Water (4)	0.5 RMB/m^3	32.0p/m^3	2.08
Steam	80 RMB/tonne	£10/tonne	65.0
Electricity	0.234 RMB/Kwh	4.7p/Kwh	0.31
Labour	1 RMB/man hr	250p/man hr	16.25

Note (1) Base £1 = 6.5 RMB

(2) Chinese product 209, U.K. rapid wetting agent

(3) Chinese product 601, U.K. emulsifier product

(4) includes effluent treatment costs.

(i) Kier processing

A comparison, based on a U.K. mill's experience, was given by the expert (ref JSDC Vol 95(1974) pg 119). This has been updated to reflect current chemical and service costs. The mill processed 11.35 tonne fabric/week by double kier scour followed by hypochlorite bleaching. This was replaced by hypochlorite desize followed by a single kier scour/bleach process, permitting 19 tonne/week production with little capital expenditure.

The relative costs of the two process routes are:

	Caustic scour - hypochlorite bleach		Hypochlorite desize - peroxide scour/bleach	
	UK costs £/tonne	China costs RMB/tonne	UK costs £/tonne	China costs RMB/tonne
Chemicals	12.5	41.8	32.1	194.4
Labour	61.7	24.7	26.3	10.5
Water	32.0	50	16.0	25
Steam	15.0	119.8	8.0	64
Electricity	4.0	20.4	2.2	10.9
TOTAL	125.2	256.7	84.6	304.8

Increase in UK chemical costs are more than offset by the savings in labour and utilities. This is not the case with Chinese costs.

(2) Continuous processing

Three continuous processing options have been compared

pad-batch oxidative desize followed by continuous peroxide bleach

continuous hot prewash followed by continuous peroxide scour/bleach

continuous three stage alkaline desize-caustic scour-peroxide bleach.

These are an updating of costings used previously by the expert in a poster presentation at the IATCC conference in 1984.

Since such comparison is often required when new investment is being planned, an assessment of equipment cost is included.

The basis for calculation is that used by Stuhmiller and Lehmann with utility use amended to take account of more efficient use of water and energy.

	Ox desize peroxide bleach		Hot wash scour/bleach		Three stage preparation	
	UK £/t	China RMB/t	UK £/t	China RMB/t	UK £/t	China RMB/t
Chemicals	36.3	198.6	47.0	247.2	34.6	164.2
Labour	4.7	2	4.7	2	4.7	2
Water (1)	8.0	12.5	7.7	12.0	11.2	17.5
Steam (2)	15.0	120	15.0	120	25.0	200
Electricity	4.4	25.7	4.4	25.7	9.2	53.8
Equipment (3)	19.9	129.4	18.4	119.6	33.6	218.4
TOTAL	88.3	488.2 =£75.1	97.2	526.5 =£81	118.3	655.7 =£100.9

Note (1) assumes no reuse of water, up to 50% saving possible by reuse.

(2) assumes heat recovery giving 50% saving

(3) assumes same cost of equipment for both countries £1=6.5 RMB.

These costings are an indication of the factors to be taken into account. Selection depends also on fabric quality, possibilities of size recovery.

Because equipment depreciation costs are a significant factor the differences between U.K. and China in unit labour and water costs have not the same effect as in the Kier bleach.

In all these costings the same manpower has been used. At current rates less efficient use in China will not have a marked effect on comparative costings.

SEMINARS

CDFDC have the full text of the papers presented at the seminars. The following summaries indicate the main points.

(i) Fabric Preparation - introduction

Economic and Technical factors influencing the selection of preparation processes were reviewed, these being:

- Chemical cost and availability
- Labour cost
- Utilities cost
- Equipment cost
- Preparation standards
- Fibre properties
- Water supply and effluent control

Parameters for assessing the quality of preparation were presented. More detailed consideration was given to fibre properties and the effects of natural and other impurities in preparation processes. These influence the possibility of reducing the number of process stages by use of oxidative desizing and/or combined scour/bleach processes based on hydrogen peroxide.

(ii) Hydrogen peroxide - Process control

Four factors interact to influence efficiency of peroxide based processes.

- Time
- Temperature
- Alkalinity
- Stabilisers to control catalytic impurities

Their interdependance was explained.

Recent developments associated with peroxide bleaching, include the use of surfactants to improve fat and wax removal and sequestrants in pretreatments to remove calcium and iron.

Bleaching is influenced also by pretreatments, especially those which remove natural peroxide stabilisers, eg. Magnesium salts.

Chemical Feed and Works control procedures were reviewed.

(iii) Stabilising Peroxide Bleaching Systems

Stabilisers are required to control the adverse effects of catalytic impurities and regulate peroxide reactivity under alkaline conditions. Magnesium salts are used to a considerable extent and the colloidal form of the magnesium complex is important. The correct order of addition of chemicals is important when preparing bleaching liquors. The chemical basis of alternatives to silicates was outlined and variations in the effectiveness of stabilisers under different conditions demonstrated.

(iv) Desizing

Composition of warp sizes and desizing options were reviewed. More detailed information was provided on oxidative desizing, particularly the factors to control in the use of alkaline peroxide or perdisulphate systems. The advantages of these processes are:

effectiveness on a wide range of sizes
improving polyvinyl alcohol size removal
possibility of partial bleaching during desizing

Use of surfactants to improve fat/wax removal can be an important factor in desizing prior to combined scour/bleach processes.

(v) Cold pad preparation

Important requirements for cold pad bleaching systems were explained:

good liquor application to give minimum 80% pick up, temperature 25 ± 5°C
good storage conditions
good washing off

(vi) Modern continuous preparation

Changes are taking place for five main reasons:

Increasing energy, labour and water costs

More severe environmental requirements

Preparation of wider fabrics with preference for open-width processing.

These have led to the development of preparation routes with minimum stages by the introduction of combined desize/scour or scour/bleach processes.

Various options and important considerations, e.g. fabric quality, stabiliser selection, were reviewed. Developments in mercerisation including those for knitted fabrics, hot mercerisation and starter mercerising were outlined.

(vii) Experimental Design. (meeting with STRI and CDFDC personnel only)

Experimental methods to simulate scouring and bleaching processes were reviewed together with usual parameters to be measured on prepared fabric.

The use of central rotatable plan (CRP) designed experiments was detailed.

APPENDIX 5 - 1 -

LITERATURE

The following literature was supplied to CDFDC . These provide references to most of the subject matter of the seminars.

re Mercerisation:

Mercerisation and liquid ammonia treatment of cotton - P.F. Greenwood JSDC Oct 87 Pg 342 H

Effect of caustic soda and liquid ammonia on the coverage of neps in dyed cotton - L Check et al Text Res Ind Sept 86

re Preparation (particularly extraction process):

Desizing and Extraction - important criteria for optimal preptreatment - Schenk and Blanckenharn (in German)

Extraction - an indispensable part of cotton finishing - Kothe, Melliand Textil. Oct 84 pg 677

Topical variation of peroxide bleaching of cotton - K. Gebert, Melliand Textil. Oct 84 pg 682

Actual variants in preparation of cotton fabrics and p.e /cotton blends - K Gebert.

Correct pretreatment - the foundation for quality in modern textile preparation. - H. Bille SDC conference paper 1986.

Optimisation in the preparation of difficult to bleach cotton qualities - P. Wurster. Text Praxis Int Dec 86 p 133

Low energy preparation of cotton & cotton blends. - Burdett & Roberts JSDC Feb 85 PG 53

A process for combined scouring and bleaching of p.e/cotton fabrics at low temperature ($NaClO_2$) - Gulrajani et al JSDC Sept 89 Pg 299

re Process Costing:

A Comparision of various Bleaching processes - Stuhmiller & Lehmann Text. Prax. Int. May82 pg 524

re Energy Monitoring

Improving Energy Efficiency - J.G. Roberts SDC conference paper 1986

Economic use of Energy in wet processes. JSDC Nov 79 pg 401

re Chelating Agents:

Sequestering Agents in Bleaching and Scouring - X. Kowalski AATCC Aug 78 pg32

Chelating Agents for metal buffering and analysis in solution - A.E. Martell.

re Laboratory proceedures:

The Violet scale - a scale for assessing the degree of desizing of starch sized fabric - Deschler and Schmedt Text Prax Int 1981 pg 331

Simple Ways of detecting process dependant catalytic damage when bleaching cotton with H_2O_2 - Schliefer et al. Melliand 1984 pg 491

Trouble shooting in preparation - a systematic approach - A.D.R. Sept 87

see also A Bleachers Handbook (Interox)

General:

Chemicals reviewed - I. Holme Text Horizon Nov 87 pg 25

Interox Publications

P.1.1.1. Hydrogen Peroxide - also manual for handling and storage

AO.2.4. Cold Pad Preparation of cellulose and blend fabrics

AO.2.5 Continuous Preparation of cellulose and blend fabrics

Bleaching Textile Fabrics - extracts from Interox Bleaching Manual to cover wool, silk, cotton with $NaClO_2$, linen

A Bleachers Hand book.

Practical aspects of conversion from Hypochlorite to H_2O_2 in kier bleaching.

Using a Texicon (chemical dosing unit)

Papers published by K. Dickinson et al (Interox)

Bleaching cellulosic fabrics with H_2O_2 in short liquor:goods ratio - JSDC Apr 72 pg 137

Economic and Technical factors influencing the selection of bleaching processess for cotton textiles - JSDC Apr 79 pg 119

Desizing with peroxygens - one approach to energy saving. - AATCC June 82 Pg 22

Evaluation of stabilisers for peroxide bleaching.- JSDC March 83 pg 86 with Interox publication FA 1.2.7.

Preparation Bleaching (review paper) Rev. Prog. Colouration Vol 14 1984 pg 1

Oxidative Desizing (review paper) Rev.Prog. colouration Vol 17 1987 pg 1