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STRENGTHENING OF THE CHINA DYEING AND FINISHING
DEVELOPMENT CENTRE

DG/CPR/87/017/11-07

CHINA

Technical report: Visit of expert in textile dyeing*

Prepared for the People's Republic of China
by the United Nations Industrial Development Organization

Based on the work of W. Beckmann,
expert in textile dyeing

Backstopping officer: John-Peter Moll,
Agro-based Industries Branch

5/55

* This document has not been edited.

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ABBREVIATIONS

CCM	Computer Colour Matching
CDFDC	China Dyeing and Finishing Development Center
CTA	Chief Technical Adviser
HT	High (dyeing) Temperature, >100 C
PE. Cel, CO	Textile material of polyester, cellulose, cotton resp.
PP	Pilot Plant
STRI	Shanghai Textile Research Instit.
COD, BOD	Chemical, biological oxigen demand

ABSTRACT

Strengthening of the China Dyeing and Finishing Development Centre CDFDC

Project DG/CPR/87/017/11-07

Technical Report - Visit of Expert in Textile Dyeing to the CDFDC
9 Nov. - 5 Dec. 1990

Visits to 7 factories were made and 7 lectures/seminars on dyeing and effluent treatment were held to strengthen the image of the CDFDC and to deepen the knowledge of CDFDC personnel.

The future role of CDFDC in textile dyeing in China was studied and discussed. Proposals of feasible fields of activities for CDFDC resulted.

Before the CDFDC can fully operate, the next steps should be:
-to further improve the capabilities and the recognition of CDFDC personnel
-to instal suitable laboratory facilities.

The dyeing activities in the Pilot Plant require further massive investments. The above steps should, however, have priority.

INTRODUCTION

As a contribution to the UNIDO-Project DG/CPR/87/017 a visit of 3 1/2 weeks duration was made from Nov. 9 to Dec. 5, 1990 by an expert in textile dyeing.

The purpose of the mission was the strengthening of the China Dyeing and Finishing Development Centre

The duties of the expert were originally outlined in the job description, Annex I. In the course of the project, because of delays in setting up the working facilities of the CDFDC, the mission had to be postponed several times, and the details of the objectives were modified slightly. After discussion with the Backstopping Officer, the CTA and with CDFDC they were:

- to give technical advice on
 - automation and optimization in the dyehouse
 - the use of reactive dyes for Cel and Cel blends
 - laboratory techniques for investigation of dyeing problems
- to conduct seminars/lectures on modern dyeing techniques and effluent problems
- to demonstrate dyeing of PE/Cel on a HT-jig and on jets
- to derive, from the above, recommendations as to the further build up of the CDFDC dyeing facilities and to its future scope of activities.

These objectives were attained as outlined in Chapters I and II.

I ACTIVITIES

A Visits to factories

Visits to 7 factories in the Shanghai area were made, conducted by CDFDC, to improve the standing of the Institute and to get information on possible and useful activities for CDFDC.

- a Shanghai Xinguang Dyeing Weaving and Shirt Manufacturing Mill
- b Shanghai No. 17 Dyeing and Bleaching Factory
- c Shanghai No. 4 Bleaching and Dyeing Mill
- d Shanghai Guang Hoa Bleaching and Dyeing Factory
- e Shanghai No. 11 Knitting Factory

- f Shanghai No. 5 Printing and Dyeing Factory
- g Shanghai No. 2 Dyeing and Printing Mill

The visits a-e dealt with dyeing, with f and g the effluent situation was the subject.

Each visit consisted of

- information on the structure of production and on equipment
- a tour of inspection covering in detail the dyeing activities or the effluent treatment. Other parts were only briefly touched
- discussion with technical personnel: equipment and procedures, esp, in comparison to European standards. Also, some technical problems were brought up.

For details see Annex II.

B Seminars, lectures

In a 3 day seminar, the following subjects as requested by CDFDC were covered by lectures and discussion periods:

- New batchwise and continuous dyeing methods for 100% cellulosics with reactive dyes
- New trends in dyeing PE/Cel blends
- Rapid dyeing of PE fabrics on jets and overflow machines
- One-bath continuous dyeing of PE/CO blends with disperse/reactive dyes
- Main trends and future developments in pigment dyeing of PE/CO blends

Copies of the above lectures were submitted to UNIDO, Vienna, before the end of October 1990 for passing on to CDFDC.

Attendance was ca 40 people each day, coming from several dyehouses and institutes.

An afternoon seminar was held on

- Effluent problems in European dyeing and finishing factories.

This seminar was asked for by CDFDC after discussions at factories and at CDFDC had revealed great interest in this subject. There were ca 25 attendants coming from waste water departments of factories, the Department of Environmental Engineering, the China Textile University, the Shanghai Textile Bureau and from other Shanghai Institutions.

A formal lecture was held at a meeting of the Shanghai Textile Engineers Society on

- Batchwise and continuous dyeing of PE/Cel blends with disperse/reactive dyes.

Attendance was ca 20 people, mainly from the industry

C Informal seminar and discussions at CDFDC

A 2 day informal seminar was held with CDFDC and STRI personnel, consisting of lectures on

- Automation in dyehouses
- Systematics and optimisation in dyeing
- Reactive dyeing of cotton.

Apart from covering further areas, in these lectures some aspects of the lectures under B were treated in depth.

Methods for investigations of dyeing processes and dyeing properties of dyes and fibers, suitable to be conducted in a (future) CDFDC laboratory were discussed with CDFDC personnel.

The findings and conclusions described in Chapter II were explained to the leading executives of the CDFDC. Agreement was reached regarding the actual situation and the scope of future activities of the CDFDC, except the Pilot Plant. (present Mr. Zhou Weitao, Mr. Cai Zhong Fang, Mr. Cai Pei Wei)

D Dyeing trial at the Pilot Plant

A trial dyeing, ruby shade on PE/CO woven fabric, on the newly installed Henriksen HT jig

- was discussed in detail at the CDFDC esp. regarding the procedure and the measurements to be taken during dyeing.
- Laboratory dyeings were executed at the facilities available to CDFDC at the China Spinning Development Centre; relevant corrections were made.
- The dyeing of 1000m of fabric was attempted but failed. For reasons not completely revealed, the machine could not be operated under HT conditions. (An element controlling the safety valve was faulty) Henriksen had not conducted a test run at HT and was unable to send a technician for immediate repair.

Other dyeing trials were not possible at the Pilot Plant.

E Meeting with Monforts, new padder

CDFDC plans to purchase a MATEX COLOR padder for the Pilot Plant and wished to have technical advice in the discussion with Monforts.

Mr. Eschke, Monforts, explained the padder in detail. Technically it is o.k. If, as promised by Monforts, a grinding unit will be made available in Shanghai, no technical difficulty is to be expected. A competitive price was also promised but not specified. At this stage, however, the purchase is not recommended (see II B).

II FINDINGS AND CONCLUSIONS

A Findings and conclusions regarding the industry

General conditions. The factories visited worked only at 50 -{ } % of capacity. Reasons given: Scarcity of raw material, export slump due to gulf crisis.

Production runs mainly on old machines, maintained only for running under the present conditions. Poor controls, esp. at Chinese made equipment, probably (but not established) high energy and water consumption; mostly narrow width. With such equipment and the personnel lacking experience outside the techniques and articles done so far, it seems very difficult to diversify or adjust to quickly changing trends or economic requirements. Principle: one mill - one article.

There are some modern machines, but frequently they are not used and the first machines to halt in case of cuts in production.

The arrangement of the machines is not always suitable for the continuity of the several steps involved in production.

Standard of housekeeping is very poor; seemingly, the dirt on machines is only removed by the running goods, equipment including in laboratories is not cleaned after use but -if at all- before next use. Dye kitchens are in a particularly deplorable state, e.g.:

-not properly separated from the dyehouse, no doors, not even plastic curtains

-primitive scales and unsuitable instruments for handling dyes and chemicals

-no care in handling dyes; drums not kept closed, dye-dust and other contaminations everywhere on floors and equipment

Health risks are imminent, dye spots on fabrics in the dyehouse were observed.

Laboratories for making recipes were not busy (lunchtime?) many pieces of modern lab-equipment had not been used nor cleaned for weeks.

There was plenty of idle personnel, but at the same time there were deficiencies in operation of machines, e.g. in plaiting, too much tension causing faults, and also in housekeeping.

Under these general conditions it is remarkable that in most factories seen, normal European standards of quality seem to be

met, assuming the fastness levels to be o.k. However, most probably they do have problems in shade reproducibility and levelness without admitting it.

To sum up this part: There are many improvements possible and necessary; although the factories do not seem to be aware of them, this is an interesting field of activity for CDFDC.

Special subjects in factory visits -dyeing

Knowledge and experience in using reactive dyes is not yet sufficient. Dyers were not familiar with the special properties of different types of reactive dyes nor with the effects of dyeing conditions on yield, rate of dyeing and levelness, in some cases not even with the recommendations in pattern cards.

Interest was found in details of recipes and techniques possible on the existing machinery, esp. in one-bath methods.

No inclination to take up cold pad-batch techniques. The reasons given were not convincing (see visits a, b); lack of knowledge and initiative are more likely explanations.

There is considerable interest in dyeing pigments on PE/CO also in dark shades. It was pointed out, as in the relevant lecture, that there is not much hope to succeed and have reasonable quality.

Computer colour matching was met by little interest, although a large number (ca 100) of CCM units have been delivered to China. Reasons given were

- poor standardisation of Chinese-made dyes
- better efficiency of visual assessment on the basis of existing recipes and shade cards
- significant differences in the different systems installed
- very few (1 -2 daily) new shades to be matched.

All these reasons do not apply except the last one, provided the system is intact and used correctly. As it seems, also in this field, the dyers still lack knowledge and initiative.

Poor quality of Chinese-made dyes - high prices of imported dyes are problems for all dyehouses. It was pointed out that inconsistent standardisation of dyes can be dealt with by a well organised control of incoming shipments, preferably using a CCM system, and correcting the recipes according to the true strength of the dye.

Buying high-priced imported dyes is justified, if the quality of the goods produced is improved (e.g. better fastness or shade consistency). This could help the industry to more exports. Savings in dyeing time or energy, however, are no valid arguments in view of the special cost situation in China (see below). This might gradually change.

Some of the significant costs in dyeing are very low in China
The following figures were given (European standards in brackets)

Labour	1...1.5	Yuan/manhour	(75)
Steam from power station	50...70	Yuan/ton	(160)
City water	0.2...0.3	Yuan/ton	(6.5)
Effluent treatment, biol.	0.15..0.2	Yuan/ton	(3...7)

1 DM = 3.2 Yuan

Because of such low costs and the actual shortage of orders, any advantage in operating costs and productivity is disregarded. Only costs for dyes and auxiliaries are considered. It should, however, be noted that the above low costs are the result of strict state policy and are bound to increase as China comes closer to the world market.

Effluent situation

All Shanghai dyeing and printing mills are required to have an own effluent treatment plant. Contrary to most European dyehouses, they cannot discharge untreated waste waters into public treatment plants. Although the calculated treatment costs in the plants visited are very low, this is a technical disadvantage. Treatment together with effluents from the city would be ecologically more reasonable and also cheaper. According to the discussions, in many dyehouses the effluent treatment does not meet the requirements, mainly limitations in COD, BOD and colour.

Should the authorities insist in the fulfilment of the requirements, improvements of the existing plants and research into adjustment of dyeing and finishing processes to these requirements will become necessary.

The above detailed findings should be understood as examples for problems and fields in which the CDFDC could be active.

B Conclusions regarding the CDFDC

The general findings were: The CDFDC is far from established. No clear scope of activities nor efficient means for activity could be seen in the field of dyeing (other fields are not considered here). There is no own laboratory. The Pilot Plant is far away and needs a lot of further investments. Doubts exist as to its future use. The financial situation of the Institute is not sound, self-support is requested but probably not realistic.

Future activities and requirements

The following activities are proposed for the CDFDC to help the Chinese dyeing and finishing industry:

- a give advice to the industry where technical improvements are recommendable (see examples in II A)
- b collect useful knowledge available elsewhere, esp. abroad; adjust it to Chinese requirements and transfer it to the industry
- c offer laboratory facilities and services ,e.g.
 - to investigate processes,detect faults and their origin, improve economy,upgrade quality
 - to test properties and quality of dyes regarding standardisation, dyeing properties, ecology
 - to do standard tests, e.g. fastness, ecological data
- d develop new processes and articles, using results of research of others and own contributions
- e educate dyers,finishers and students in modern techniques

Notes:

d is the most difficult activity,and will probably take much time and effort to accomplish. The other activities should be prepared immediately.

Acceptance of the CDFDC by the industry as a partner for progress and development is a vital point. To be accepted, CDFDC must offer know-how and activities (services) which are not available within the industry but found useful by the dyers. To imitate the normal dyehouse-skills is not recommended.

There seems to be an overlap with activities of other institutions in Shanghai:

- STRI, Dyeing and Finishing Department and
- Shanghai Dyeing and Finishing Research Institute.

The requirements for the above activities are not yet fulfilled. Additional efforts are considered necessary primarily in

- redefinition of the objectives of CDFDC in view of the above; motivation of CDFDC personnel accordingly
- further development of know-how of CDFDC personnel as initiated by the fellowships and the visits of experts
- invitation of domestic and foreign instrument and machinery builders, dye suppliers, researchers to present their products and ideas; establishment of close (incl. personal) contacts to key representatives

-extensive exchange of information with the industry, close contacts

-establishment of laboratory facilities (see Annex III) This laboratory must be very close to the office and working place of CDFDC personnel, and it should be kept as a showcase, unlike the neglected labs in the industry, to promote a positive image.

Full-scale machinery is not primarily required for the activities listed above (see below).

Financial situation

The Government requests financial self support of the CDFDC. At present, there is little hope to reach that goal.

Institutes in Germany with activities like those proposed are financed by different sources:

-considerable support from state, city or industry groups

-payments for services (advice, tests) to individual factories on the basis of a price list

-money for development projects, selected and detailed by committees, paid by industry funds or by state subsidies. Results of this work are made public

-money for projects initiated by a factory, interested in the results. The factory pays for the work and gets the results exclusively

-some of the employees are also members of university staff and get paid by the university

None of the institutes is fully self-supporting. None does regular production for money.

It is suggested to find out, which of the above means of financing are feasible in China and establish the necessary requirements, which will probably include the requirements given above.

Pilot Plant

CDFDC representatives expect financial support by the Pilot Plant, esp. the coating unit. Whether dyeing activities in the Pilot Plant can contribute substantially is impossible to assess without a market study on commission dyeing. Such a study should be made available. At present, the business situation of dyehouses does not warrant optimism. It is certain, however, that substantial investments are still necessary before the installed jigs and jets can be operated in a professional manner. Even higher investments are required for a cold pad-batch unit.

Another purpose of the PP is to serve development work as a field of experimentation and demonstration.

The visit to the PP showed: the plant is far from finished. Several of the machines listed in the report on the CTA's 3rd visit as to be delivered by end of June 1990 were not yet set up

or not ready for use. Essential elements of the infrastructure for operating the batch dyeing machines were incomplete or still missing, e.g. laboratory equipment (CCM, intact photometer, lab dyeing machines, instruments for on-line pH and T measurement) dye kitchen, facilities for handling, preparing, drying and finishing. Moreover, 2nd or 3rd hand machinery which probably is useless for the immediate objectives of the CDFDC is waiting for assembly.

For the objectives proposed, full-scale machines are not really necessary. Unless the CDFDC machines are much better equipped with controls and measuring equipment, full-scale testing is better done on machines used in regular production, because this saves cost and is more realistic. This is especially true for continuous processes. (Similar arguments are found in the Technical Report of the Project's Expert in Textile Printing)

Investment in the dyeing activities of the Pilot Plant should concentrate on the infrastructure of the batch dyeing machines already installed (see above) These investments, however should not have priority over the investments in the laboratory at the site of the CDFDC.

RECOMMENDATIONS

The following points refer to the field of dyeing. For details see II

1. Redefine the objectives of the CDFDC, sort out the overlaps with other institutions, motivate personnel accordingly
2. Acquire as much know-how from others as possible by invitations to seminars, travel etc. especially in fields outside the usual dyehouse skills; try to get established as a partner to the industry
3. Set up a suitable efficient laboratory at the premises or next to the CDFDC (1st priority for investment)
4. Complete infrastructure for batch dyeing in PP (2nd priority)
5. Do not invest in full-scale conti dyeing machinery, not even cold pad-batch, unless plenty of funds are available
5. Look for financial resources similar to those existing in Germany. The industry does need services and should pay for them

ANNEX I

JOB DESCRIPTION
DG/CPR/87/017/11-07/J-13102

Post title Expert in textile dyeing

Duration 1 month

Date required April/May 1989

Duty station Shanghai with limited travel within the country

Purpose of project The strengthening of the China Dyeing and Finishing Development Centre.

Duties The expert in textile dyeing will

- demonstrate the utilization of jiggers and jet dyeing machines with micro-processor control in producing small lots with high reproducibility;
- give technical advice on the use of computer-controlled weighing systems;
- conduct course/lecture on
 - (i) the factors affecting reproducibility in textile dyeing, with particular reference to the compatibility of dyes,
 - (ii) the application of colour measurement and computer colour matching in the dyehouse.

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

Qualifications Textile chemist with high level theoretical and practical knowledge of dyeing technology, computerized colour matching and familiarity with process control and computerized dye kitchen.

Language English

Background information See separate sheets

ANNEX II

Details of visits to factories.

a Shanghai Xinquang Dyeing, Weaving and Shirt Manufacturing Mill

12. Nov. 1990

Accomp. by Mr. Zhou Weitao, National Project Dir.

Mr. Xu Ninglun, Sen. Engin. CDFDC

Mr. Dong Huiqing, Ass. Engin. CDFDC

Members of Staff Mr. Li Lin Min, Deputy Dir.

Mr. Qu Guo Quan, Vice Dir. of Techn. Res.

Mr. Huang Cheng Yao, Deputy Chief, Techn.

Established 1933 2700 employees

Production: 40 mio m / a shirt fabric, all PE/CO, 90 cm wide;
90% 65/35, 10% 40 / 60, mercerised, 33% white, rest dyed;
mostly for export, standard European quality.

1 mio shirts / a , trade name SMART

Capacity : 70 mio m / a Profits: 16 mio Yuan / a

Equipment, processes: 180 looms, shirt sewing facilities;

3 continuous pretreatment ranges, open width, Chinese and Japanese, conventional sequence (singe - desize - bleach - mercerize); washing after mercerization not always sufficient to remove alkali.

4 units pad - air - IR(gas) - dry - thermosol

5 units pad - air - IR(gas) - dry - pad - steam - wash - can dry

2 KÜsters padders, others domestic, old machines, running 2step procedure, 40 m /min, usual temperatures are attained, most units are permanently heated. Few controls;

1 Mahlo rectifier, 2 old vertical stenters, gas fired.

Minimum batch size 2000 m , colour change takes "only a few minutes"

Vat, reactive and Indigosol-type dyes are used, > 90% domestic, vats decreasing, reactivities increasing, type of reactivities not clearly defined, presumably DCT and VS; no cationic aftertreatment of reactive dyeings; washing procedure after dyeing seems to be the same for reactive as for vat dyeing (except oxidation).

Dye kitchen : dirty, primitive, esp. the scales. They disperse or dissolve powder dyes and weigh (often after days of storage with occasional blowing in of air bubbles) the dispersion or solution. Danger of sedimentation and crystal growth for disperse and possibly hydrolysis for reactive dyes. Shade reproducibility?? Levelness??

Laboratory : divided in sections for testing and for recipe making; in the latter simple paddler, thermofix-machine; steaming imitated by hot treatment in plastic wrap.

Main points in discussion : Alternatives for dyeing PE/CO. Principles and recipes for one-bath continuous methods.

Methods for dyeing CO (they would like to go into 100% CO), esp. cold pad-batch. In test runs, they have found inadequate shade reproducibility. It was explained, why cold pad-batch is found well suited by European and US dyers; details, recipes. Pad-steam method, also with FLEXNIP, details, recipes.

Recommendations: to look more closely into cold pad-batch. To improve the dye kitchen.

If they went into 100% CO, they could use the ranges with thermosol equipment for one-bath dyeing of PE/CO and the ranges with pad-steam for CO; but they needed additional washing ranges after the thermosol units.

Cost situation (see II A) .

b Shanghai No. 17 Dyeing and Bleaching Factory

13 Nov. 1990

Accomp. by	Mr. Xu Ninglun, Sen. Eng. CDFDC
	Mr. Dong Huiqing, Ass. Eng. CDFDC
Members of staff	Mr. Lu Weng Ying, Director
	Mr. Hu Lei Hua, Deputy Director
	Mr. Jiang Xin Gen, Dir. of Techn.Division
	Mrs. Xia Li, Dyeing Engineer
	Mr. Dong Bo Wei, Dir. of Laboratory
	Mr. Huang Weixiong, Dir. of Dyeing Workshop

800 employees

Production 50 mio m/a, shirt poplin, all CO, mostly 140cm wide all mercerized, 90% dyed, mostly for export; good standard European quality;

Capacity ca 50 mio m/a

Equipment, processes :

Pretreatment: Several ranges, singe - pad (caustic, size is starch) - wash (rope) - kier boil (8 hours) - wash - bleach (chlorine) - wash - open - mercerize - wash - dry

Dyeing : 4 units pad - air - IR(gas) - dry - pad - steam - wash dry; 2with KÜsters padders, other machines Chinese or Japanese; dryers after IR 2 hotflues, can-dryers. Stone-old steamers with sump, few controls. 40 m/min

One range for naphthols (reds or blacks), one for Phthalogens, two ranges for vats and reactives, no directs, no Indigosols; washing procedure after reactive dyeing as after vats, except oxidation. Some resin treatment (decreasing), no cationic aftertreatment.

Dye kitchen similar to Xin Guang (see a)

Laboratory similar to Xin Guang; they use molten-metal technique to imitate pad-steam fixation.

Discussion : No interest in discussing PE/CO nor in general information on reactive dyeing. Cold pad-batch was treated in extenso. According to Mr. Dong they encountered the following difficulties:

- domestic suppliers have no complete range of suitable dyes
- Vinylsulfone dyes are not suitable because of alkali instability
- the final shade and levelness can be checked only after the (long) batching time
- poplins do not dye level
- colour yield is only ca 30 - 40 % of that with pad-steam.

It was pointed out that most difficulties can be overcome by following the recommendations of the dye suppliers.

Problems: They have "weather marks" on certain dyed goods, a fading or change of shade after exposure to the atmosphere for some time. Since no softeners susceptible to yellowing by antioxidants are used, these marks are probably gas fading (ozone, NO₂). A test like the AATCC gas-fading test was recommended to select dyes.

Shade changes during soaping cause difficulties in shade reproduction. This is specific to vat dyes; the wash-off procedures after reactive dyeing were explained.

c Shanghai No. 4 Bleaching and Dyeing Mill

14 Nov. 1990

Accomp. by Mr. Xu Ninglun, Sen. Engin. CDFDC
 Mr. Dong Huiqing, Ass. Engin. CDFDC

Members of Staff Mrs. Liang Pei Qiong, Director

 Mr. Wang Jiafu, Dir. Dyeing & Finishing
 Workshop

 Mr. Zhou Hongxiang, Dep. Dir.

 Mr. Cheng Wenhui, Dir. Technical Div.

 Mr. Qiang Yuedi, Dep. Dir.

 Mr. Shen Rongrong, Engin. Technical Div.

 3 assistant engineers

1340 employees

Production : 25 - 30 mio m/a shirting material and lightweight apparel; 70% CO, rest PE/CO and some PE/Viscose, 120 - 140 cm, partly mercerized, much for exports; no weaving.

Capacity : 50 - 60 mio m/a (lack of orders, gulf-crisis, unsatisfactory cost situation, high price for raw material).

Equipment, processes : No other factory visited had so many pieces of modern equipment in production and laboratory. Most versatile in production, but low utilisation of these possibilities, esp. of the modern equipment.

Pretratment of CO similar to Shanghai No.17 (rope), of PE/CO similar to Xinguang (open width), but with Mather pressure steamer and washing range; for PE/Viscose open width Menzel pretreatment range with H₂O₂ bleach.

Dyeing partly continuous, partly batchwise;
2 units pad - air- IR(gas) - dry - pad - steam - wash - dry
1 of them also suitable for ... dry - thermofix;

2 ASISA - jigs, 180 cm, 1988, not used, no lifting device!
6 old Chinese jigs, 140 cm used for CO < 1000m
5 Argelich ATYC jets, 550 kg used for PE/CO < 2000m
2 Hisaka Circular jet, 250 kg " " " "

1 Monforts stenter with padder for heat setting and coating

On conti machines, vats, reactive and sulfur dyes are used for Cel, disperse dyes for PE part. PE/CO is dyed thermosol - pad-steam or pad - thermofix . In batchwise dyeing, directs and reactive dyes are used for Cel. Almost all dyes are of domestic origin.

Dye kitchen : similar to Xinguang (see a)

Laboratory : in the dyeing section, besides the usual Chinese lab-equipment they have :

- 1 Benz conti steamer
- 1 Benz conti-thermofix-unit
- 1 Roaches laboratory jet
- 2 different Roaches HT-beaker dyeing machines

all the above with automatic time-temperature controls. The machines were quite new, dirty and looked unused.

Discussion

Their procedures for dyeing PE/CO on jets put emphasis on levelness at the cost of yield of fixation, build-up and shade reproducibility. (low salt-conc., high temperature, short time for fixation) They did not differentiate between different types of reactive dyes and did not follow recommendations in pattern cards. Examples for procedures incl. wash-off used in Europe were given.

Further points of discussion : Pad-steam process for reactive dyes, esp. use of 2nd padder and water seal. Tailing problems, correction of initial dye concentration in padder in case of substantivity or preferential water absorption (negative substantivity). Pigment dyeing of PE/CO in deep shades (so far not possible), precipitation and build-up on rollers (unbalanced binder - catalysr - system, premature cross-linking), wash-out articles.

d Shanghai Guang Hua Bleaching and Dyeing Factory

15. Nov. 1990

Accomp. by Mr. Xu Ninglun, Sen. Engin. CDFDC

Mr. Dong Huiqing, Ass. Engin. CDFDC

Members of staff Mr. Song Jian Guo, Dep. Dir.

Mr. Zhou Ke Yan, Dep. Technique Section Chief

730 employees

Production : 24 mio m/a woven apparel, 60% CO, 40% PE/CO, mercerized, 90 - 130 cm, 200 -250 g/m, partly for uniforms exports to 60 countries

Capacity : 26 mio m/a

Equipment, Processes

Pretreatment conventional open width (see a), H₂O₂ bleach

Dyeing, 2 ranges, pad - air - IR(gas) - dry - pad - steam - wash and similar with thermofix unit instead of steamer. Küsters padders, other equipment Chinese. Minimum batch size 3000m; speed and temperatures of driers adjusted to fabric.

Dyes used are disperse, vats, naphthols, some reactives and pigments (incl. fluorescent).

Discussion : Few problems in normal production, shade matching (visual, based on shade cards and established recipes), reproducibility. Interest in reactive dyes and dark shades in pigment dyeing.

Continuous dyeing methods for reactive dyes were discussed; pad-thermofix method for CO and PE/CO for best coverage of dead cotton, characteristics of reactive dyes, migration, antimigrants also for pigment dyeing (see relevant lectures) and cold pad-batch.

e Shanghai No. 11 Knitting Factory

16 Nov. 1990

Accomp. by Mr. Yu Ninglun, Sen. Engin. CDFDC
 Mr. Dong Huiqing, Ass. Engin. CDFDC

Members of staff Mrs. Shao Li Hua, Dep. Chief of Techn. Sect.
 Mr. Chen Fu Hing, Vice Dir. Engin.
 Mr. He Mian Mian, Dir. of Research Div.
 Mrs. Ze Xiahong, Ass. Engin. Research Div.
 Mr. Li Guochang, Technician, Dyeing and
 Finishing Workshop

500 employees in dyeing and finishing

Production : Knitting and garment making; bleaching and dyeing 2.5 ... 3 tons, bleaching only also 2.5 tons daily, circular knits, partly mercerized, CO, some ramie, some PE/CO, not dyed; smallest batch ca 1 ton (6000 pieces)

Capacity for dyeing : 5 ... 6 tons daily

Equipment, Processes : 2 pretreatment ranges:

a) conti winch wash - kier-boil, kier chlorine - conti H_2O_2 - wash (Oshima, Japan); b) kier H_2O_2 - conti wash (Chinese)
Optical bleaching agents, OBAs, for whites applied on winch, softeners on conti immerse - squeeze - hydroextract unit. Mercerizing on Chinese made (Dornier similar) machine running at 25 m/min.

In 1986 a Küsters bleaching range was installed; this was removed in 1989 because of too much tension.

Dyeing: 4 old 250 kg winches, simplest controls, built in liquor circulation not used; operated at 15:1 liquor ratio. These machines were in use.

Also installed 1 new Fongs 2x120 kg atmospheric jet and 1 new Fongs 2x150 kg HT overflow machine. These machines were dirty, obstructed by storage of boxes and waste material. had apparently

not been used for some time.

Several driers and calenders, 3 US made Sanforizing machines, different makes; no tumblers.

Mostly Chinese reactive hot-dyeing dyes and OBAs, some silicone softeners (type unknown, domestic).

Dye kitchen : similar to Xinguang (see a)

Laboratory : in dyeing section only primitive standard equipment, no CCM

Discussion : occasional problems mentioned and discussed:

- unlevelness (streaky, skittery)
- special wet fastness requirements not met; then, sometimes, imported dyes are used at the expense of customers
- softness not satisfactory (frequently), also on ramie
- shade of white not as required, although blue shading dyes are used
- dark spots appear on the goods, not removable by bleaching, related to the weather conditions "most probably mould, fungus" closer inspection revealed: dye spots, different colours, only on exposed parts of goods waiting for processing in the dyehouse.

They dye with very little salt, and calculate it in % owf (up to 40% owf ~ 21 g/l), also short times for fixation, regardless of type of reactive dye. Instructions in pattern cards are not always followed. Relevant recommendations were explained.

Further advice: regarding OBAs and softeners, to submit samples of untreated and treated fabric to suppliers (e.g. Bayer China) for suitable proposals. Besides quality, also the procedure of application can be improved (no separate steps); to try modern tumblers (Magin-Obermaier) to improve the hand ; to reorganize the dye kitchen and clean up the Dyehouse to avoid dye spots and improve efficiency; to use the jet and overflow.

f Shanghai No. 5 Printing and Dyeing Factory

28. Nov. 1990

Accompanied by Mr. Shen Song Xiang, Sen. Engin. CDFDC

Ms. Chen Xiang Hong, Ass. Engin. CDFDC

Members of staff Mr. Yao Jianguan, Vice Dir.

Mr. Wang Guo Zhu, Engin., Waste Water Treatm.

The purpose of the visit was to inspect the wastewater treatment plant.

Production : 50 mio m/a printed and dyed

For further information refer to Technical Report IO/R of 12.7.90 by G.S.A.Corbishley on the visit of this factory.

Wastewater treatment : ca 2000 m³ of wastewater / day, pH ca 7, T= 20 - 40 C, are treated in a 2 stage aerobic biological plant; aeration with surface agitation and sedimentation with dwelling times of ca 8 h in each stage; highly charged water from engraving and printing workshop, ca 1/10 of total is separated and flocculated with Al-hydroxide and Al salts.

Results are:

COD from 800 - 1000 mg/l to ca 250 mg/l
BOD from 300 mg/l to ca 15 mg/l
other parameters not measured.

Colour in the effluent is a problem.

Treated water is discharged into public sewage treatment plant.

Sludge is treated in filter press, then deposited.

The cost was given as

- 0.1 Yuan/m³ for bio treatment incl. investment; in Europe cost would be 1 - 4 Yuan (lower than mentioned page 10, low COD)
- 0.7 Yuan/m³ for flocculation.

Discussion :

Differences between China and Europe regarding effluent treatment in dyeing and printing factories. Ways to reduce colour (changes in production, elimination of colour), use of special flocculationagents for reactive dyes (LEVAFLOCR, Bayer, COLFLOC, Cibageigy) and chemical means.

Shanghai No. 2 Dyeing and Printing Mill

29. Nov. 1990

accomp. by Mr. Shen Song Xiang, Sen. Engin. CDFDC
 Ms. Chen Xiang Hong, Ass. Engin. CDFDC
Members of staff Mr. Yao Ming Hua, Vice Dir.
 Mrs. Yao Jiang Yuan, Engin. Effluent Treatm.
 Mr. Tang Jiau, Ass. Engin.

The purpose of the visit was to inspect the wastewater treatment plant.

Production : ca 70 mio m/a. For further information see Technical Report IO/R 157 of 12.7.90 by G. S. A. Corbishley on

the visit of this factory.

Wastewater treatment is done since 1971. They discharge into a river, about 7000 m³/day.

2 stage biological aerobic treatment, aeration by surface agitation, dwelling time ca 4.8 h, sedimentation dwelling time ca 3.5 h, surfac not known. Sludge content ca 3 g/l, oxygen ca 6mg/l ?

Water from engraving is flocculated separately, then it goes into the biology.

After the biology, part of the water is ozone-treated, mainly to remove colour. Ozone generation 30 kWh/ kg O₃, consumption 50 g O₃ / m³, 1.67 kWh / m³ (high cost). The other part is flocculated with FeIII - and Al - salts, on a new flotation range.

Results, bio stages : COD from 500 to < 200 mg O₂/l, BOD from 100 to 30 mg O₂/l. Problems: high COD / BOD ratio, dwelling time too low, often pH too high; colour is not a problem, requirement: no colour in treated effluent after dilution 100:1.

Effects of ozone treatment and flocculation: COD < 150 mg O₂/l, otherwise not specified.

Costs: bio stages	0.14 Yuan/ m ³
flocculation	0.4 "
fresh water	0.26 "

Discussion : differences regarding wastewater treatment in dyehouses between China and Europe. Reduction of COD/BOD ratio by selection of products (limited). Reduction of pH by revising the processes or neutralization on the basis of measurement or alkali use. Flocculation with LEVAFLOC R or COLFLOC to replace ozone treatment.

ANNEX III

Equipment required at the CDFDC laboratory for dyeing

(not for dyehouse lab at PP ; not a complete list;
not in order of importance)

- CCM unit, software for shade matching, pass-fail, colour difference, control of strength and hue, recipes, retrieval, inventory; capacity for lists of dyes, auxiliaries, fibers and procedures, cost calculation, optimization etc.
- collection of typical dyes, auxiliaries and fibers, with updated information leaflets, pattern cards and other relevant information from suppliers
- standard chemical equipment esp. for extraction and dilution
- good scales (electronic, with printer), good instruments for pH and redox measurement (calibration, handling)
- spectrophotometer incl. UV
later: COLOREX (Sedo) or equivalent controller of dyeing process
- equipment for paper- and thin-layer-chromatography
later: HPLC (high pressure liquid chromatography) instrument
- an adequate selection of laboratory and small-scale (some kgs) dyeing machines: time/temp controllable, emphasis on imitating liquor ratio and dwelling times of production units, accessoires for dosing techniques; driers, thermofix units and steamers preferably not conti
- instruments for fastness tests
- sampler to cut samples from running fabrics
later: IR instrument to measure temperature on running fabrics
- later: Instrument for DTA (differential thermo-analysis)
- microscope