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STRENGTHENING OF THE CHINA DYEING AND FINISHING  
DEVELOPMENT CENTRE

DG/CPR/87/017/11-03

CHINA

Technical report: Visit of Expert in Textile Printing\*

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

Based on the work of G.S. Anthony Corbishley,  
Expert in Textile Printing

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United Nations Industrial Development Organization

\* This document has not been edited.

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ABSTRACT

Strengthening of the China Dyeing and Finishing Development Centre.  
Project DG/CPR/87/017/11-03.

Technical Report - Visit of Expert in Textile Printing, April 1990.

The report details the activities of the expert in textile printing with the China Dyeing and Finishing Development Centre, (CDFDC).

28 March - 19 April 1990.

Visits were made to five Shanghai Dyeing and Printing Mills; each visit was of one day's duration and took the form of introduction to the activities, tour of the factory and technical discussion.

A two day formal lecture with discussion periods covered a range of technical topics requested by CDFDC.

The future role of CDFDC in the development of the textile printing industry of the People's Republic of China (PRC) was reviewed and discussed in depth.

Suitable subjects for development work by CDFDC were proposed.

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#### INTRODUCTION

As a contribution to the UNIDO project - The Strengthening of the China Dyeing and Finishing Development Centre - a visit of three weeks duration was made to Shanghai in March/April 1990 by an expert in textile printing.

The duties of the expert as set out in the job description were:

- to assess research work conducted at the CDFDC in the field of printing cotton and polyester/cotton fabrics.
- to advise on the line of research to be pursued.
- to conduct a course for research workers and high level technical staff from factories in up-to-date printing techniques.
- to give technical advice in product development of high quality fashionable printed textiles for apparel and decorative outlets.

The performance of these duties is reported under activities.

## RECOMMENDATIONS

1. It is highly unlikely that the work of CDFDC in the development of textile printing will be self-supporting. Recognition of this is an essential pre-condition to further progress.
2. Development work in textile printing can and should start now, using existing and available facilities, on technical questions where the printing mills are in need of assistance, specifically in pigment printing.
3. The Pilot Plant now under construction should be provided with small scale laboratory equipment for textile printing and with full width sample printing facilities. The acquisition of a full-size production model rotary screen printing machine is not recommended.
4. CDFDC should be provided with equipment for computer colour match prediction and computer aided design for experimental, training and demonstration purposes in order to keep pace with current developments.

The proposal that such an installation could be a source of revenue requires further study, specifically market research.

Again it is noted that equipment for computer colour match prediction is already in place and under-utilised in some Shanghai mills. This equipment could be used by CDFDC personnel, in the short-term, for training and familiarisation.

5. Adequate provision should be made by CDFDC for the acquisition and storage of at least sample quantities of a representative range of dyes and textile chemicals from traditional suppliers, worldwide, so that developments are not limited or frustrated by the limited range of products available from domestic sources.

## I ACTIVITIES

A. Visits to factories in the Shanghai area

Factories visited were:

Shanghai No. 1 Printing and Dyeing Factory.

Shanghai No. 2 Dyeing and Printing Mill.

Shanghai No. 3 Printing and Dyeing Works.

Shanghai No. 5 Dyeing and Printing Factory.

Shanghai No. 1 Silk Dyeing and Printing Factory.

Each visit consisted of a summary of activities and a tour of the factory in the morning and an afternoon discussion with the technical personnel.

The technical discussions covered a wide range of questions and problems specific to the mills, such as:

- Printing on cotton with reactive and vat dyes.
- Resist printing reactive under reactive dyes.
- Printing on viscose.
- Discharge printing on cotton, viscose, silk and wool.
- Dyes for silk printing.
- Variables in steaming.

but a serious problem, common to all the printworks, concerned pigment printing, which was originally undertaken using imported systems of European origin, but now uses exclusively products of domestic origin. The binders now in use are products of an appropriate chemical type but are not correctly formulated or elaborated to be suitable for use in pigment printing and consequently problems arise during production due to:

- miscleaning of printing rollers.
- blocking of screens.
- difficulties in cleaning wash blankets.
- harsh handling of printed goods.

Also, the pigment dispersions provided by the domestic producers are not the most suitable for pigment printing.

These problems have been discussed in detail with CDFDC personnel and guidelines for development work have been laid down.

#### B. Seminar

A two day seminar consisting of lecture and discussion periods was held, for which the following subjects had been requested by the National Project Director:

- the present situation and future trends in pigment printing.
- review of properties including methods of application of binders and thickening agents.
- discharge and resist printing.
- technical and commercial advantages and disadvantages and trends of copper roller printing versus flat and rotary screen printing.
- laser engraving.

All the above subjects were covered by the lecture, in technical detail and in the context of their position in the textile printing industry as a whole.

A copy of the lecture was provided in advance for CDFDC and a copy is available for UNIDO if required.

#### C. Experimental

It had been proposed to conduct trials in the laboratories of Shanghai No. 3 Printing and Dyeing Works on a number of topics arising from the discussion periods:



1. Formulation of binders for pigment printing.
2. Formulation of pigment white printing paste.
3. Reactive resist under reactive dyes.
4. Pigment resist under reactive dyes.
5. Discharge printing on silk.

However, owing to an acute shortage of textile chemicals, even in sample quantities, only 2 and 4 could be attempted.

Trial 2 was only moderately successful, again due to the absence of required products.

Trial 4 was wholly successful.

The non-availability of quite commonplace textile chemicals, even in sample quantities, is a serious deficiency which should be remedied without delay.

## II CONCLUSIONS

A. Introduction

Detailed discussions were held with the personnel of CDFDC, and in particular with:

Mr CAI PEI-WEI Assistant to NPD

Mr CAI ZHONG FANG Vice-Director of CDFDC

on the future role of the CDFDC in the development of the textile printing industry of the PRC.

The role of CDFDC in the development of the textile printing industry of the PRC is foreseen by the management of CDFDC to consist of two separate functions:

- the use of a pilot plant to investigate and to initiate technical developments, and to solve problems on behalf of the textile printing industry.
- the installation of the latest design and colouristic technology (Hi-Tech) to provide services for the textile printing industry.

Both of these should be regarded as wholly worthwhile and desirable objectives, but it should be established at the outset that it is unlikely that either of these functions will be self-supporting. It is to be expected that CDFDC activities on behalf of the textile printing industry will require financial support in perpetuity, either by direct government subsidy or by a levy on the industry. It is most important that this condition is recognised and clearly accepted by all concerned well in advance of any investment being undertaken.

B. Pilot Plant

In considering the installation of a pilot plant within CDFDC for the development of the textile printing industry it is important, first of all, to understand that there is a fundamental difference between batchwise processing and continuous processing. Full-scale pilot plant development

of batchwise processes is relatively simple; techniques developed, for example, on one dye-jig can readily be extended to a hundred or more identical units simply by replication. On the other hand, a full scale pilot plant for the development of textile printing processes is a full scale printing works, and, furthermore, one which is engaged in regular full scale production because continuous processes only work well when run continuously. It is assumed that it is not the intention of CDFDC to undertake the construction of another printworks at this time.

But the installation of, say, a full scale rotary screen printing machine and a continuous steamer, without the intention of, or equipment or personnel for full scale production is not a viable proposition. If used for experimental purposes only such a printing machine would stand idle most of the time, consuming space and investment capital, because every time it was used it would consume large quantities of chemicals and cloth, the value of which would not, in most instances, be recoverable, and especially so because the operative team would, inevitably, lack experience. Similarly with a steamer; when starting from cold, most continuous steamers for textile printing require to be in operation for long periods before a stable equilibrium condition is attained, but in comparison a steaming experiment is unlikely to last more than a few minutes.

For these reasons it is strongly recommended that CDFDC should be provided with full width sample printing equipment capable of producing up to, say, ten metres of material using standard production size rotary screens, together with a batchwise steamer, e.g. a star steamer.

In addition there should be provided small scale laboratory equipment for printing and steaming. In this way developments can be introduced to the textile printing industry in a systematic manner:

- fundamental development in laboratory.
- full width sample, printed, steamed and washed in the pilot plant.

- full width sample, printed in the pilot plant but steamed and washed in the factory.
  
- production trial in the factory.

Furthermore, CDFDC could start now to carry out useful development and problem solving functions on behalf of the textile printing industry by making use of the small scale equipment which already exists at Shanghai No. 3 Printing and Dyeing Works, within a clean and well organised laboratory environment. The equipment is underutilised and no doubt could be made available for use by CDFDC personnel. In other words, development work on textile printing projects can start now, and at low cost.

There are several clear advantages to this approach; firstly, experience gained in the use of the equipment will enable the correct investment decisions to be made; secondly, starting a development programme now will enable CDFDC personnel to acquire the necessary skills; and, thirdly, there can be no stronger justification for further investment in CDFDC than the evidence that useful work is already being undertaken, using existing facilities.

Indeed, evidence that CDFDC has the ability and the will to fulfill a useful development function should be a pre-condition of further investment for it is essential to avoid the situation where continuity of interest is sustained only by continuity of expenditure.

An opportunity was provided to inspect the pilot plant project and it was encouraging to note that development work is intended to be undertaken in a spacious environment, well lit during daylight hours; but if it is intended that work shall continue during the hours of darkness, a lighting survey would be advisable to ensure that adequate lighting provision has been made.

It was observed that a quantity of old machinery was standing outside the pilot plant awaiting installation. In the strongest possible terms it is

advised that this machinery is moved to the location most appropriate to its age, design and condition, that is, the scrap-yard.

It was also observed that the pilot plant is some distance away from the offices of CDFDC, presently located within the buildings of the Shanghai Textile Research Institute. For the purposes of development work in textile printing, continuous supervision is required; the supervising engineers should be located at the pilot plant for the whole period of the development work and consideration should be given to the provision of appropriate transport or accommodation.

#### C. Hi-Tech

In order that the textile printing industry of the PRC shall keep pace with recent technical developments it is essential that the necessary facilities are installed within CDFDC, and at an early date, because such developments are advancing at an accelerating pace. Such an installation could be used as a training and testing facility for the whole textile printing industry of the PRC, where individual mills are considering the acquisition of their own equipment.

The provision of such equipment could proceed step-by-step, starting with the installation of a computer aided design (CAD) facility which could offer designing services such as the provision of films for screenmaking or designs drawn in repeat and shown in alternative colourways for submission to customers. As a second step, a laser engraver could be added as a demonstration model for the whole industry and, later, a sample size automatic colour kitchen could be added, also for demonstration purposes. However, it is most important that when the first equipment is ordered, the ultimate target is made known, for it is much easier and cheaper to ensure compatibility of the units in the first instance.

Another valuable investment would be the provision of spectrophotometric colour measurement and computerised colour match prediction facilities,

to provide optimised recipes for both the dyeing and printing industries, to determine the colouristic characteristics of available dyestuffs and to advise on their most economic use.

However, such developments in the textile dyeing and printing industries will need to be accompanied by parallel developments in the domestic dyestuff manufacturing industry; computerised colour measurement requires dyestuffs to be produced to a high degree of standardisation, whilst automatic colour kitchens require dyestuffs supplied as liquids or free flowing granules. Technical progress in dyestuff manufacture could probably be most readily achieved in partnership with a Western dyestuff producer.

It has been proposed that Hi-Tech installations within CDFDC such as computer aided design and laser engraving could be operated as a self-supporting service to the whole textile printing industry, but this proposal requires very careful investigation. Hi-Tech developments save time and labour and can readily be justified in high wage economies, but their viability in low wage economies is more problematical.

Of course, this is a short-term outlook; China may not always have a low wage economy, but in the short-term it should be anticipated that CDFDC services may not be self-supporting and before the provision of such services can be regarded as a satisfactory commercial enterprise a market survey should be undertaken:

- do the textile printing mills of the PRC want to make use of these services and do they know the charges they will have to pay?
- if a laser engraving service is to be offered to all the rotary screen printing factories of the PRC, how many different mesh sizes, screen diameters and screen widths will it be necessary for CDFDC to keep in stock as blank screens, what will the stock cost and who will pay for it?
- is the advantage of speed of laser engraving lost if it takes thirty minutes to engrave a screen and thirty hours to deliver it?

These questions are not criticisms of the very worthy objectives of CDFDC but they need to be answered before further commitments are undertaken.

#### D. Tasks

It has already been mentioned that facilities exist which would permit the conduct of technical development work to start immediately, in advance of the installation of textile printing equipment within the pilot plant of CDFDC. Subjects which would benefit from such work include:

- binders for pigment printing. Present systems in use involve simply the mixing of an acrylic copolymer into an emulsion thickener and it is hardly surprising that the resultant product has poor running properties and a harsh handle. A literature search into patents would give some indication of the trends of past developments and advice has been given to CDFDC personnel on recipe formulation.
- pigment dispersions for printing. Formulations have been provided to show the trends in the development of pigment dispersions, including the preparation of pigment white dispersions.
- dyes for discharge printing on silk. Lists of potentially suitable dyes have been provided for further examination.
- discharge agents for silk printing. Recipes have been provided for the preparation of printing pastes with a history of successful results.

Another useful activity for CDFDC, requiring no laboratory facilities, would be to advise on the modernisation of some of the older factories. Of the five factories visited, Shanghai No. 1 Silk Dyeing and Printing Factory is scheduled to be closed and amalgamated with Shanghai No. 5 Silk Dyeing and Printing Factory and need not be considered further. The other four factories were all founded about sixty years ago; they are old and old fashioned in lay-out and construction and, although there has been investment in new machinery, all four factories, if they are intended to remain in

production would benefit greatly from internal improvements which could be achieved by the use of domestic resources without requiring the input of foreign exchange. For example, all four factories, to a greater or lesser degree, need:

- thoroughly cleaning and repainting
- replacement or repair of leaking steam valves
- identification and clearing of walk-ways and fire exits
- reconstruction of colour kitchens with new floor and new drains
- clearing and repairing of areas around printing machines

A survey of these mills could be undertaken by CDFDC personnel and detailed proposals put forward for a step-by-step rehabilitation of existing facilities to be completed before further investment is considered. But it should be noted that these are not exclusively Chinese problems, on the contrary there were many mills in Western Europe of similar age and in similar condition and although many have been closed and demolished, a number have been modernised and visits to some of these by CDFDC personnel would be instructive to see what can be achieved.

It is, however, considered essential that the introduction of modern technology must be preceded by a marked improvement in industrial hygiene and housekeeping.



## ANNEX 1

A. Personnel contacts in CDFDC

Mr ZHOU WEI-TAO	National Project Director (NPD)
Mr CAI PEI-WEI	Assistant to NPD
Mr CAI ZHONG FANG	Vice Director of CDFDC
Mr CHENG CHENG-KANG	Director of Project Planning Department
Mr SHEN SONG-XIANG	Director of Project Development Department
Mr XU NINGLUN	Director of Administrative Office
Mr ZHANG CHANG KANG	Engineer
Mr WU PEI QIANG	Assistant Engineer, Translator
Ms CHEN XIANG HONG	Assistant Engineer, Interpreter

B. Other contacts

Mr DING LI	Deputy Director, Shanghai Textile Industry Bureau
Dr ZHU XING	Professor. Ministry of Textile Industry
Ms DAI SHU QING	Deputy President. Shanghai Textile Research Institute
Mr PAN ZHENG ZHUNG	Director. China Dyeing and Finishing Information Service
Mr ZHONG CHANG SHENG	Ministry of Textile Industry

## ANNEX 2

Details of factories visited

Visit to: Shanghai No. 1 Printing and Dyeing Factory 2.4.90

Personnel: Mr Wang Yin Sheng Chief Engineer  
Ms Zhang Jin Mei Vice Chief Engineer

Visitors: Mr Xu Ninglun CDFDC  
Ms Chen Xiang Hong CDFDC  
Mr G.S.A. Corbishley UNIDO

The factory was constructed in 1928, by Japanese owners, and has been enlarged and modernised since 1949. The factory is working 24 hours a day in three shifts, six days a week, and employs 2400 people.

Production capacity: 100 million metres/year

Present actual production: 85 million metres/year

Qualities: Cotton 100% and PES/CO 65 : 35 in roughly equal amounts of woven constructions of about 150gms/M<sup>2</sup> for shirts and blouses, mostly exported.

Small quantities, about 2.5 million metres/year of cotton furnishing fabrics.

Equipment and ProcessesPre-treatmentCotton

Singe and quench in alkali

Alkali Scour in J-boxes, rope form

Hypochlorite Bleach in J-boxes, rope form

PES/CO

Continuous open width peroxide bleaching.

Mercerising

3 chain mercerising of which two process two ends together in two layers.

Dyeing

Continuous open width range.

PES/CO is dyed in two stages

Pad - dry - thermofix for PES

Pad - dry - steam (3-4 minutes) for CO

Open width washing and soaping

Printing

Four copper roller printing machines of local manufacture.

It is planned to import two rotary screen printing machines.

In-house design and engraving facilities.

Steaming

Two Arioli festoon steamers.

One roller ager of local manufacture.

Washing

Four open width washing machines each of 11 compartments.

Finishing

Five stenters, each with padding mangle.

Two glazing calenders.

Dyes

For cotton: Azoic; Reactive; little Pigment

For PES/CO: Pigment; Disperse/Reactive

95% of all dyes in use are of domestic manufacture and are purchased on the basis of their own assessment of suitability (price/performance).

Visit to: Shanghai No. 2 Dyeing and Printing Mill 3.4.90

Personnel: Mr Yao Ming Hua Director Assistant  
Mr Liu Zhi Lu Chief of Technological Section

Visitors: Mr Xu Ninglun CDFDC  
Ms Chen Xiang Hong CDFDC  
Mr G.S.A. Corbishley UNIDO

This factory was originally owned by Japanese, constructed in 1929, but enlarged and modernised since 1949. The factory is working 24 hours a day, three shifts, six days a week, and employs 2400 people.

Production capacity: 100 million metres a year

Present actual production: 80 million metres a year

About 70% of production is exported.

Qualities: 65% PES/CO, 35% Cotton, of which 30% white goods  
30% printed  
20% dyed  
20% colour woven

### Equipment and Processes

#### Pre-treatment

#### Cotton

Singe and quench in alkali then in rope form

1 line: Kier boil, hypochlorite bleach

1 line: continuous scour in J-box then hypochlorite bleach

Three mercerisers

PES/CO

Three lines open width, continuous pre-treatment, hypochlorite bleach, mercerise, peroxide bleach.

Dyeing

Cotton: Continuous pad steam dyeing with vat or indigosol dyes.

PES/CO: Continuous dyeing. Pad, dry, thermofix disperse dyes then pad-steam or pad-develop on cotton with vat, reactive, indigosol or naphtol dyes.

Printing

5 copper roller printing machines of domestic manufacture.  
1 Zimmer rotary screen printing machine.

PES/CO

Disperse/Reactive systems

Pigments

Cotton

Reactive and naphtol often used together.

Steaming

5 steamers of domestic manufacture.

Finishing

5 Stenters

4 pre-shrinking machines of domestic manufacture.

Visit to: Shanghai No. 3 Printing and Dyeing Works 4.4.90

Personnel: Mr Fang Zhong Meng Director  
 Ms Wu Xiang Shan Vice Chief Engineer  
 Mr Zhai Zhi Pan Chief of Tech. Dept.

Visitors: Mr Xu Ninglun CDFDC  
 Ms Chen Xiang Hong CDFDC  
 Mr G.S.A. Corbishley UNIDO

The factory was built in 1930 under French ownership, later transferred to English owners (CPA). It is the third largest printworks in Shanghai, producing about 70 million metres a year, all cotton; sateen, poplin and plain weave, all for export. About 50% printed, 30% dyed, 20% white. Downproof Sateen is a speciality product.

The factory has about 2000 employees of which there are 100 Engineers. Emphasis is on quality improvement with new machines imported during the 1980's.

### Equipment and Processes

#### Pre-treatment

Singe and quench in alkali

Two lines rope scour and hypochlorite bleach

One continuous pen width pad-steam peroxide bleaching range by Kusters.

#### Dyeing

On jigs or continuous

Reactive or Indigosol

Printing

Four copper roller printing machines, of domestic manufacture.

Three Stork rotary screen printing machines RD3 and RD4.

Printing 80% reactive dyes.

Remainder Naphtol or Pigment.

Direct printing only, no discharge.

Some naphtol/citric acid resist under reactive dye.

Steaming

Two Arioli continuous festoon steamers.

Wash-off

Open width, continuous.

Laboratory

This factory has excellent laboratory facilities consisting of, inter alia,

Zimmer rotary laboratory printer

Werner Matthis drier and thermofixer with mangle

Arioli star steamer

Pad-steam range (Benz ?)

There is also a separate room containing a spectro photometer and several computer terminals for colour assessment.

All this equipment is kept in a clean and spacious environment but obviously under-utilised and could perhaps be made available for use by CDFDC in the short term.

Visit to: Shanghai No. 5 Dyeing and Printing Factory 5.4.90

Personnel:	Mr Wang Xing Zhang	Vice Director
	Mr Shi Guo Qian	Vice Director
	Mr Yao Jiang Yuan	Vice Director
	Mr Han Sheng Shi	Vice Chief Engineer
	Mr Liu Guang Sheng	English Teacher

Visitors:	Mr Xu Ninglun	CDFDC
	Ms Chen Xiang Hong	CDFDC
	Mr Wu Pei Qiang	CDFDC
	Mr G.S.A. Corbishley	UNIDO

The factory, formerly Japanese, was built in 1934. It has 1500 employees, including 40 Engineers and 8 Senior Engineers and works 24 hours, 3 shifts, to produce 50 million metres a year out of a capacity of 60 million metres. Approximately equal quantities of cotton and PES/CO are processed in woven fabric constructions of 120-150gms/M<sup>2</sup>. All for export. Output is 10% white goods, 50% dyed, 40% printed.

### Equipment and Processes

#### Pre-treatment

Continuous scour and bleach in rope form followed by mercerising and then open width peroxide bleaching on a continuous pad-roll machine.  
Three chain mercerisers.

#### Dyeing

Cotton: Continuous pad-steam  
Vat or reactive.



PES/CO

Continuous pad thermofix, pad-steam.

Disperse/reactive - 1 step

Disperse/Vat - 2 step

Also Disperse/ Indigosol

Disperse/ Naphtol

Printing

Three copper roller printing machines of domestic manufacture

Two Buser flat screen printing machines producing a variety of conventional, direct, discharge and resist articles on cotton:

- direct printing with reactive dyes and Naphtols
- discharge printing on direct and reactive grounds with Rongalite C
- resist printing in typical Naphtol styles e.g. aluminium sulphate resists under Variamine Blue.

Printing on PES/CO with

- disperse/reactive dye systems
- pigments

Steaming

Two steamers of domestic manufacture.

Wash-off

Two open width washing ranges.