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APPLICATION OF RESEARCH RESULTS IN EASY CARE COTTON FABRICS  
IN THE TEXTILE INDUSTRY

DP/IND/82/011

INDIA

Terminal report\*

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

Based on the work of the  
Ahmedabad Textile Industry's Research Association  
prepared by the Assistant Director

Backstopping officer: J.P. Moll  
Agro-based Industries Branch

United Nations Industrial Development Organization  
Vienna

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\* This document has not been edited.

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I. DEVELOPMENT PROBLEM AND IMMEDIATE PROBLEMS ATTACKED

A UNDP/UNIDO Project IND/72/035/37 designed to increase the research capabilities of ATIRA was completed in 1978. A research project was then prepared to make use of these facilities in the areas of durable press cotton, flame retardancy and soil release finishes.

The development objective is 'to introduce new chemical finishes at the commercial level which will upgrade the quality and utility of cotton fabrics, especially garments and thereby to stimulate purchases of cotton textile items from all industry sectors for both domestic consumption and export'.

The immediate objective concerned is 'to carry out specific pre-investment steps as specified in the project activities, in order that the results of laboratory research in easycare cotton fabrics already completed at ATIRA with UNDP assistance can be applied to broad industrial use in the mill sector'.

A. Plan of Work

The project was conceived in 1978 and finally activated in December 1982 with the appointment of project staff etc., in the implementing institution. However, the Chief Technical Adviser (CTA) was available only from September 1983 as a UNDP input. In the absence of any detailed plan of work drawn up by CTA, work in the following areas was started:

(a) Establishing the conditions for preparatory processes and standardisation of the formulations for easycare finishing together with application conditions.

(b) Evaluation of different fibre compositions and fabric constructions i.e., cotton:polynosic:polyester::33:52:15 and cotton:polyester::85:15 and 67:33.

(c) Selection of product areas, namely - shirtings, suitings, bed-sheets and dress fabrics.

CTA visited ATIRA in September 1983 and finalised the plan of work (Annexure-I). The main modifications in work content from that outlined in general in the project document were - (a) elimination of flame retardancy aspect and (b) inclusion of "dilute" blends of polyester with cotton in the research and development work.

**B. Equipment**

The list of equipments, as given in the project document, is reproduced in Annexure-II.

**II. OUTPUTS PRODUCED AND PROBLEMS ENCOUNTERED**

. As mentioned earlier, the project was started in December 1982. Activities carried out have been reported during its course by (a) three reports from CTA (b) three reports from project coordinator (c) progress reports - six monthly to UNDP and quarterly to Government of India and (d) status reports. All these reports are listed in Annexure-III.

The UNDP Officers in New Delhi and UNIDO Head Quarters in Vienna have provided excellent cooperation in execution of the project and in the revision of the list of equipments together with the allotted budget for the same.

Project activities and outputs will be considered under the following subject areas.

- A. Equipment provided
- B. Personnel trained
- C. Contribution of the expert
- D. Research programme

A. Equipment Provided

Modifications in the list of the equipment were found necessary by CTA. As per the revised plan of work, gel permeation chromatograph was not required. Looking to the recent trends in the manufacturing of easycare finished garments by the pre-cure process only, and non-availability of a suitable garment curing oven in the market, it was decided in consultation with CTA to drop this equipment and to include (a) Minimum Application Equipment and (b) Spectrophotometer.

Equipments received under the project are listed in Table-I. Some accessories for (1) Data Processing and Acquiring System and (2) Spectronic 2000 are yet to be received. These are as follows:

(1) Data Processing and Acquiring System

(i) The diagnostics software is supplied on a wrong medium i.e., RL02 instead of RX50. This needs replacement.

(ii) No documentation/manuals have been provided for the diagnostic software. These are essential as any software without documentation will be of limited use.

(iii) One of the power cables is for 125 V. instead of 240/250 V.

(iv) The MICRO/R SX operating system that has been received by us does not contain the utilities to transform the files already created under earlier (RT-11) operating system. Hence, the requirements, essential to compile and analyse the earlier data already stored in the system and to facilitate completion of further work expeditiously, were given to UNDP in our letter No. CTD/4.6/JRM/6147 dated 7th June 1988. These are as follows:

- o Micro/R SX Advanced Programmer's kit
- o Fifty Preformatted RX-50 Floppies (5 x 10/Box)
- o Word Processing Software (Micro/R SX DEC type or A-to-Z WP including its integration system and kit)
- o Micro/R SX Sort/Merge
- o Micro/R SX Cobol and
- o Micro/R SX SSP-11 and LSP-11.

The priorities for the above would be as per the list prepared.

TABLE-I  
EQUIPMENTS PROVIDED BY UNIDO/UNDP

Item	Price US. \$	Date of Receipt
(1) Kannegiesser Utility Body Press	10708	1-5-83
(2) Pfaff Lockstitch Single Needle Thread Cutter	1803	1-7-83
(3) Pfaff Double Chain Stitch with One Needle	2033	1-7-83
(4) Laboratory Drying Curing and Heatsetting Apparatus	22826	1-5-83
(5) Starvue Reader-Printer	5484	1-9-83
(6) PT-4060 Photo Copier Ricoh	7065	1-12-83
(7) Data Processing and Acquiring System	40238	1-10-85
Accessories for Data Processing and Acquiring System	28878	7-5-88
(8) Limited Application Equipment Triatex MA	52415	1-7-85
(9) Spectrophotometer 2000	8341	2-4-86
(10) ACS-1400 ATE Quality Control System	33650	31-7-87

(2) Spectronic 2000

In place of five packages of chart naper, five package of accessory installation kit were received. This needs replacement. This has been pointed out to UNDF vide our letter CID/4.6/JRM/245 dated 7th April 1988.

B. Personnel Training

It was originally planned to have three study tours. However, CTA, in consultation with project authorities, has reduced to two. The details about the study tours are shown in Table-II.

TABLE-II  
STUDY TOURS

Name of the Trainee	Period	Location	Remarks
J.R.Modi	April-May 1984	West Germany, U.K., U.S.A. and South Korea	Visits were interesting and informative. Visited industrial laboratories, research institutes and garment manufacturing units. Attended AATCC meetings on Testing Methods.
C.S. Rao	June-1985	West Germany, U.K. and U.S.A.	The study tour was well organised except visits at U.S.A. Overall the tour was quite useful and informative. Visited industrial laboratories, research institutes and garment manufacturing units.
D.K. Jain	May-1985	Switzerland	The training was specific with respect to Triatex MA.



(a) Study Tours arranged by UNDP

The experience gained in the study tour by Shri J.R.Modi was found to be extremely useful for the project work and in providing additional technical input. The plan of the work for the project was modified as a result of the experience gained from the study tour. The important modifications were as follows:

- (1) Garment curing oven is not required and should not be ordered.
- (2) Garments should be stitched as per requirements for the pre-cure process.
- (3) As far as suiting is concerned, 100% cotton fabric should not be taken for wearer trial. In its place, polyester:cotton::48:52 blend fabric should be included.

The fields of study in case of the tour of Mr.C.S. Rao were (1) easycare finishing (2) garment manufacturing and aftercare and (3) developments in wet processing. Mr. Rao had detailed discussions on fabric/garment care labelling and laundering and drycleaning practices followed in European countries. As far as (3) is concerned, Mr. Rao has identified the following areas to get firsthand information.

- (i) Effect of liquid ammonia process on properties of easycare finished Indian fabrics.
- (ii) Evaluation of hot hypochlorite bleaching/scouring.
- (iii) Evaluation of limited application technology
- (iv) Evaluation of microwave technology
- (v) Non-woven disposables
- (vi) Knit wears
- (vii) Pollution control.

Out of these, the work on evaluation of limited application of easycare finishing solution using Triatex MA has been completed in this project.

(b) Training at Triatex International AG:Zurich

As a part of the purchase order, Triatex suggested to train one person from ATIRA for a period of three days at their works. After getting approval from UNDP/UNIDO, Dr.D.K. Jain was sent in May 1985 for training. After return, Dr. Jain commissioned the Triatex MA and standardised different variables.

C. Contribution of Expert

Mr. T.A. Marsland, CTA, visited ATIRA three times and offered the assistance expected in the execution of the project work. The period and duration of the visits and the contribution of CTA are shown in Table-III.

TABLE-III  
CONTRIBUTION OF CTA

Period	Duration	Project Contribution
September 1983	4 Weeks	(a) Prepared the work plan of the project (b) UNDP budget was revised (c) Plan for study tour No.1 was prepared
July 1984	4 Weeks	(a) Preparation of Specifications for (i) Data processing equipment and (ii) minimum application equipment (b) Review of the work carried out (c) Preparation of job description for (i) marketing expert (ii) marketing organisation (d) Plan for study tour No.2 was prepared
March 1985	2 Weeks	(a) Preparation of terms of reference for National Marketing Organization-Textile Fabrics & Garment (b) Modification in the plans for study tour No.2

In the third tripartite review meeting, it was decided that further services of CTA would not be required for the project.

D. Research Programme

Studies have been generally carried out following the proposed research programme outlined by CTA (Annexure-I). The important technical outputs have been covered in various publications, listed in Annexure IV, and the Synopsis of these have been given in Annexure-V.

The main activities of the project work can be divided into different stages as mentioned below.

- (a) Preparatory work
- (b) Pilot scale trials and mill trials
- (c) Wearer trial, evaluation and selection
- (d) Manufacturing of fabrics and garment field trial.

Over and above these, work related to the following aspects have been also completed.

- (1) Evaluation of Triatex MA and high pressure squeeze systems for resin finishing applications.
- (2) Formaldehyde release in resin finished fabrics.
- (3) Effect of finishes on dyed cotton fabrics.
- (4) Variation in shade of fabrics for garment manufacture.
- (e) Market research
- (f) Dissemination

(a) Preparatory Work

(1)

Important aspects studied were selection of (i) conditions for scouring and bleaching (ii) catalyst systems and (iii) softeners and (2) heatsetting and easycare finishing of cotton:polyester::85:15 and 67:33 blended fabrics. With these studies, the conditions for bleaching were standardised so as to impart high crease recovery with reduced strength losses to the fabric before easycare finishing. Formulations for easycare finishing and curing conditions have been standardised to impart required crease recovery with reduced losses in the physical properties of the finished fabric. These results were

communicated to UNDP as Draft Progress Report No.1(27th February 1984). The technical details on some of the aspects are discussed in the synopsis presented in Annexure-V.

(b) Pilot Scale Trials and Mill Trials

As mentioned in the plan of work, the products selected were (1) shirting (2) suiting (3) bed-sheet and (4) dress fabric.

The fabric samples before finishing for the above mentioned four products were collected from different mills and evaluated at ATIRA for various properties after easycare finishing. The properties were compared with ATIRA standards which are more or less similar to international standards from wellknown firms. Out of these, certain fabric samples were selected for wearer trial. These findings were communicated to UNDP as Draft Progress Report No.2, 4th December, 1984.

(c) Wearer Trial, Evaluation and Selection

Five types of shirting fabrics, two types of bed-sheeting fabrics, two types of suiting fabrics and two types of ladies' dress fabrics have been evaluated. For comparison, polyester-cotton blend fabrics with high polyester content or with different fabric constructions were included. The easycare finished garments along with pertinent questionnaire were distributed for wearer trials. The fabrics and the garments were also washed in the laboratory and were assessed after certain number of washes for various properties. From the results (1) two types of shirting or ladies' dress fabrics (2) one bed-sheet fabric and (3) one suiting fabric were tentatively selected for large scale wearer trial. The work was reported to UNDP as Draft Progress Report No.3, 27th May 1985, whereas two Research Notes have been published from the work carried out. The technical details are discussed in the synopsis given in Annexure-V.

(d) Manufacturing of Fabrics and Garment Field Trial

The original plan for field trial was for four products i.e., shirtings, suitings, bed-sheets and dress-fabrics. However, owing to changes in the market demand for certain textile products and the non-availability of the garment curing equipment, CTA had modified the plan of work and reduced the number of products to two only i.e., shirtings and bed-sheets.

The funding required for a garment field trial is enormous and ATIRA did not have the financial resources to support the work effort of this scale. No special rupee funds had been provided by the Government of India except normal grant-in-aid at 50% of the net revenue expenditure. Utilization of UNDP funds for the expenditure in Indian rupees on the garment field trial was contrary to Government policy. Several efforts were made by ATIRA to convince private textile mills to take part in the garment field trial at their expense. However, no such mill came forward, probably on account of the depressed state of the textile industry as a whole; wherein the main problem for the mills was one of sheer survival. In such circumstances, the Ministry of Textiles used its good offices to persuade the National Textile Corporation (NTC), in a meeting held on August 1985, to cooperate with ATIRA in this project by (1) providing required fabrics (2) bearing the cost of manufacturing the garments (3) conducting garment field trial and (4) collecting information on market research. Subsequent to this decision, NTC, Tamilnadu and Pondicherry (TN&P) Ltd., and NTC (Maharashtra North) Ltd., sent in all sixteen samples for evaluation, out of which seven samples from NTC (Tr. & P) Ltd., were selected: two cotton shirtings, two C/P(67:33) blend shirtings, two cotton bed-sheets and one C/P(85:15) blend bed-sheet. Samples from NTC (MN) did not meet the fabric specifications laid down by ATIRA.

NTC (TN & P)Ltd., was requested to manufacture these fabrics in February 1986. In spite of this subsidiary's eagerness to complete the work as soon as possible, the easycare finishing of the fabrics could be completed only in September 1987 and the stitching of the shirts in January 1988. For wearer trial, about 1500 shirts and 850 bed-sheets were dispatched to NTC (TN&P)Ltd., Coimbatore, whereas about 400 shirts and 250 bed-sheets were kept at ATIRA.

The wearer trial went on smoothly at ATIRA and data could be collected upto 20 washes for both shirts and bed-sheets. Information collected from NTC(Tn&P)Ltd., was only for shirts upto ten washes. In spite of our repeated reminders, no information for bed-sheets has been sent to us.

The analysis of the information collected revealed that under conditions of bulk manufacture, it is indeed possible to impart satisfactory easycare properties to the fabrics without intolerable loss of durability. A dilute blended (33% polyester: 67% cotton) fabric after easy care finishing can perform as well as a polyester-rich fabric. The ranking in general can be as follows:

C/P bed-sheets	)	Very good to excellent
Cotton bed-sheets	)	
C/P Shirts		Very good
All cotton shirts		Satisfactory to good

The only problem with the shirts was of excessive seam puckering. After a few trials, the type of thread was selected and the tension to be applied during stitching were standardised. The machines were adjusted for required tension. However, during actual stitching, this tension must have been changed by the workers without intimation. The problem can be overcome by selecting experienced garment manufacturing units and creating awareness among the workers about the rigid control required for the tension during stitching of such garments.

(1) Evaluation of Triatex MA

Triatex MA system, high pressure squeezing system and normal padding system were compared for application of resin finishing solution. It was observed that the properties imparted to the fabric finished on Triatex MA or by high pressure squeezing are more or less equal and better than those obtained by normal padding of the fabric. However for a country like India, vacuum extraction system for low liquor pick-up should prove more versatile and less costly as compared to TRIATEX MA system. Annexure-V gives more technical information about the comparative performance.

(2) Release of Free Formaldehyde

The international standard for release of free formaldehyde is 1000 ppm. The easycare finished fabric by ATIRA process releases 875 ppm free formaldehyde. In case the free formaldehyde is high, an alkaline wash with soda ash after curing or addition of urea to the pad bath (no after-wash) reduces significantly the formaldehyde release. More technical information is given in the synopsis given in Annexure-V.

(3) Effect of the Finishes on Dyed Fabric

It has been mentioned in the literature that easycare finishes change the shade of the dyed fabric. A study was, therefore, carried out on the effect of ATIRA easycare finishing process on the shade of reactive and naphthol dyed fabrics. The important conclusions drawn from the study are (i) the extent of variation in tone or in the light fastness of the dyed fabric is dye-specific, and (ii) there is an improvement in wash fastness and in rubbing fastness due to easycare finishing. More details are given in the synopsis presented in Annexure-V.

(4) Variation in Shade in Fabrics for Garment Manufacturing

In garment manufacturing, long lengths of the fabric with absolutely uniform colour are required. However, in practice, there will be variation in the shade of the fabric dyed in the same batch or in different batches. In order to study the extent

of variation, about a hundred samples have been collected in each shade from different layers at the time of garment cutting. The examination of these samples revealed that the variation in shade is of the order of 15 to 20%. About 40 to 64% of the samples collected are within the limits of variation in shade. When examined over a short length of two metres, the shade variation is small and can be acceptable for forming part of a single garment. The organization of garment manufacturing must be modified to take care of this fact. In Annexure-V is given the technical information about this work.

(e) Market Research

To start with, Government of India has insisted on a national organisation/individual to undertake the work on market research. UNDP has agreed to release the funds subject to the approval of Government of India. However, according to the Government, this was against the policy. ATIRA did not have the financial resources to support the work. It was then agreed that the easycare finished samples/shirts along with the properties and manufacturing prices would be forwarded to different agencies connected with export through NTC. Details about the export potential would be collected through these agencies by NTC units who would then report to ATIRA. In a joint meeting with Government of India and UNDP, it was then agreed to approach Apparel Export Promotion Council (AEPC) for market survey. A meeting was held with garment exporters but representatives from only two firms attended the meeting. Details about cost of the fabrics and garments were presented during the meeting and shirts and bed-sheets were given to the representatives. AEPC has also published the write-up given by us in their publication. Samples of easycare finished fabrics were sent to AEPC to show to garment exporters. However, no information has been received so far on export potential.



(f) Dissemination

The original plan included (a) project publication/report and (b) Seminars (Commercial and Market Research Inputs).

A list of publications together with paper presented arising out of the project work is indicated in Annexure-IV. With these publications, the information on easycare finishing technology was communicated to the industry in India. The knowledge is also communicated through various training programmes conducted by ATIRA for the industry. As the market research input is practically nil, it would not be appropriate to hold a seminar on this subject.

III OBJECTIVES ACHIEVED OR LIKELY TO BE ACHIEVED  
IN THE NEAR FUTURE

The immediate objective as mentioned in (I) has been met for all practical purposes and the development objective has been partly fulfilled. Some of the fabrics after easycare finishing have the properties comparable with international standards. Thus, ATIRA has now a complete package starting from spinning to easycare finishing and culminating in an appropriate technology for manufacture of garments/made ups to offer to the domestic textile and garment industries for producing this type of textiles and clothing as per international standards. However, information could not be collected for domestic consumption and export market and hence, the possible extent of use of the know-how cannot be predicted. In case, the efforts are made by garment manufacturers to assess the export market, if required, by sending easycare finished garments (samples) in the style prevalent in the international market, then one can get some idea about export market. This information can then be utilised for implementation of the project findings.

As far as domestic consumption is concerned, dilute blends of polyester with cotton should be easycare finished and put in the market to compete with ordinary "rich" polyester blend fabrics, for example, 48% polyester:52% cotton and 67% polyester:33% cotton. At equivalent wash and wear properties, the easycare finished fabrics will be more comfortable and cheaper than rich polyester blend fabrics.

#### IV FINDINGS AND LESSONS LEARNT

##### (A) Findings

The following conclusions can be drawn from the experience gained and work carried out on the project.

##### (a) Equipments Provided

All equipments provided are working satisfactorily at ATIRA. Equipments such as ACS Spectrophotometer, Spectronic 2000 etc., will be useful to the exporters of textiles and dyes in evaluating their samples as per international standards.

##### (b) Research Results

A complete package starting from spinning to easycare finishing has been developed to offer to the textile industry to manufacture easycare finished fabrics/garments. Further work is required to explore the potential of exporting easycare finished garments. For domestic consumption, the market for easycare finished dilute polyester blend fabrics should be explored. This will be more comfortable to wear as compared to high polyester blend fabrics for tropical climate such as ours and can also reduce the consumption of polyester.

##### (B) Lessons Learnt

Some of the major problems faced during the project work and our views to overcome these are summarised below:

(a) Research Programme

The activities of the project went on smoothly and as per time schedule till the starting of the work related to large scale consumer acceptance field trial and market research. For both these activities, separate fund was not provided and therefore the project authority had to depend upon NTC for (1) supply of approved quality fabrics (2) Processing of the fabrics in one of their units (3) conducting consumer acceptance field trial, etc. Even after one false start, the fabric eventually supplied was of inferior quality to the one that was approved. The manufacturing and the processing of the fabrics took longer time than planned. Limited information could be collected on consumer acceptance field trial for the shirts/bed-sheets supplied to NTC. As far as market research is concerned, no information could be collected as one had to depend upon the agencies where there was no control from the project authority. In case, sufficient fund had been allotted, the project could have been completed as per the plan of work prepared by CTA and with greater satisfaction.

(b) Training

The study tour programmes were not finalised till last day. Occasionally, the person was informed about the programme when he reached a particular country. Due to this, some of the important visits had to be dropped and it became difficult to adjust the programme so as to utilise all the working days. A little early finalisation of the visits will solve most of the problems.

(c) Equipment

The problems mentioned below are of general nature and are discussed for considerations and actions in future. As far as this project is concerned, some of these problems were solved by taking appropriate actions.

The main problems are as follows:

(1) When the project authority receives a copy of the order, it is too late to suggest any modifications. Many times, the name of the equipment is only mentioned in the order and hence the equipment and the accessories have to be checked with packing list only. At this time, project authority knows about accessories received.

(2) After checking the equipment and the accessories, it is found that some of the important accessories have not been supplied. Manuals to solve trouble-shooting problems or for maintenance are not supplied with the equipment. This creates problems during starting of the equipment and during repairing of the same when goes out of order.

(3) Sometimes, the supplier does not indicate clearly about the accessories which are fixed in the equipment and which are supplied separately. This makes difficult to check the supply with the packing list.

(4) The accessories supplied along with the equipment can be sometimes checked physically, however, it is difficult to check its working. In such circumstances, signing of the receipt voucher may create problem afterwards.

#### Suggestions to Solve Problems

(1) Before putting the order, the copy of the quotation should be passed on to the Project Authority for comments. If required, the copy of the order should be made available to the Project Authority. List of accessories fixed in the equipment and supplied separately should be clearly indicated in the quotation/order/packing list.

(2) While ordering the equipment, required manuals should be ordered.

(3) If necessary, the project authority should be allowed to do direct correspondence with the supplier of the equipment after this is received, with copies to UNDP, Delhi and UNIDO, Vienna. For this, the supplier of the equipment should have information about the institution where the equipment has been supplied.

(4) In case, there are agents in India for any equipment, UNIDO, Vienna, should insist for the services of such an agent to check the equipment and the accessories when received by the project authority and to install and start the same.

(5) Two vouchers, one for physical stock and other for satisfactory working, should be provided along with the equipment.

#### V RECOMMENDATION

(1) The remaining work on market research especially for export market, should be completed by providing separate fund.

(2) For the domestic market, possibility of marketing easycare finished dilute polyester blend fabrics should be explored.

(3) Awareness/training for garment manufacturers to stitch from easycare finished fabrics, garments without seam puckering is a must to sell the final products in export or in domestic market. The methodology to carryout this function can be finalised in a meeting with garment manufacturers who are interested to stitch garments from easycare finished fabrics.

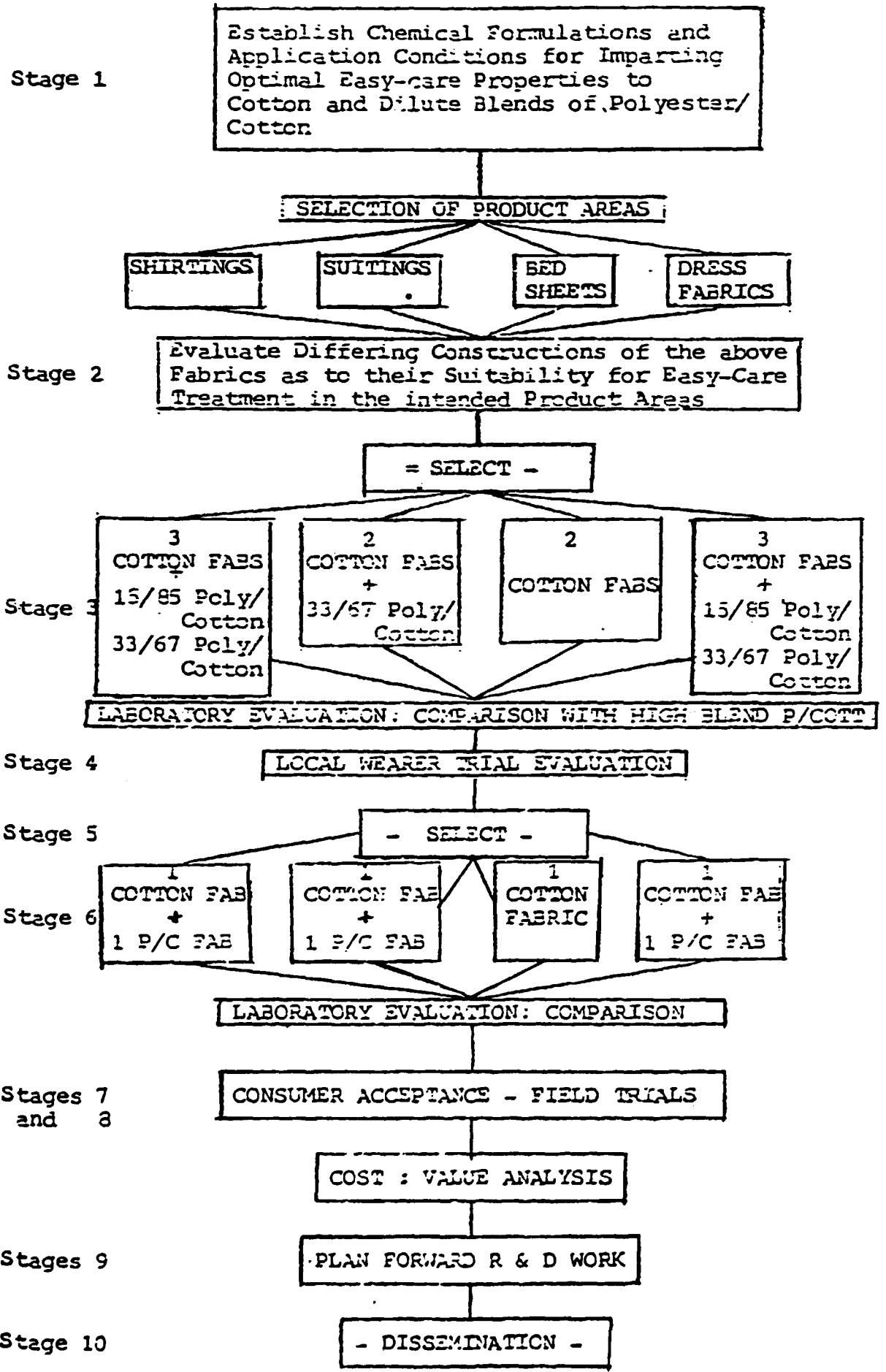
ANNEXURE - I

WORK PLAN - PROJECT PROGRESS STAGES

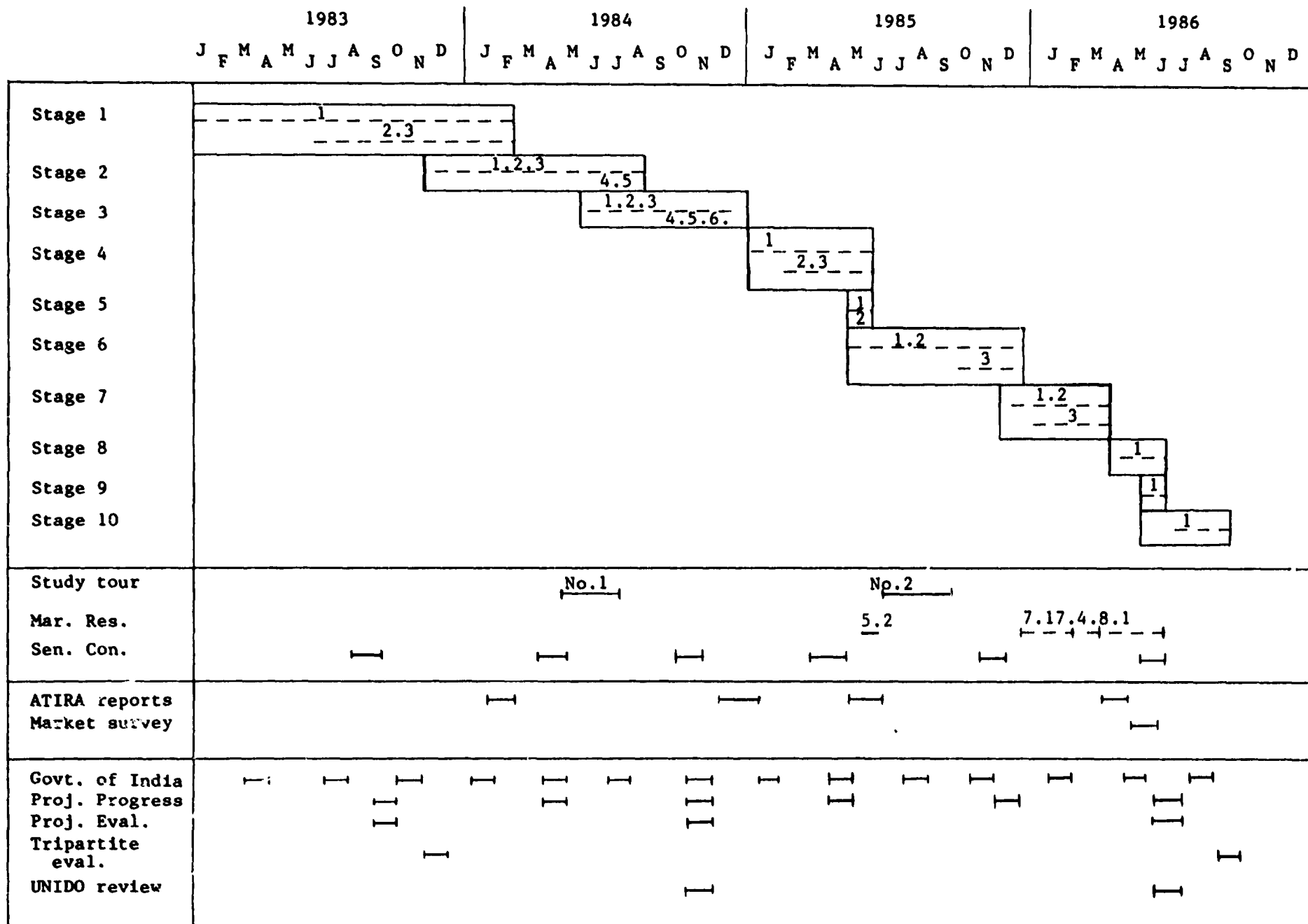
Stage		Main Activities	Duration Months	Elapsed Time Months
1 Preparatory work	1	Acquisition, installation and commissioning equipment		
	2	Laboratory evaluation of preparation methods, formulations and conditions for optimal easy-care properties		
	3	Progress report		
		Sub Total	14	14
2 Pilot scale trials	1	Product selection	)	
	2	Selection of fabric ranges	) 9	5
	3	Pilot scale manufacturing and processing trials	)	
	4	Laboratory evaluation of these results	) 2	1
	5	Rationalisation of fabric ranges	)	
		Sub Total		6
3 Mill trials	1	Manufacture of mill trials fabric	) 6	3
	2	Supervision of mill processing trials	)	
	3	Establishing standards for garment manufacturing	2	
	4	Laboratory testing and evaluation fabrics	)	
	5	Laboratory comparative Testing of 48/52 and 67/33 polyester/cotton blends	) 2	1
	6	Progress report	) 1	-
		Sub Total		4
4 Wearers trials	1	Supervision - Garment manufacture	3	2
	2	Preparation + supervision wearer trials	3	2
	3	Laboratory garment assessment	1	
		Sub Total		4
5 Evaluation + selection	1	Evaluation of wearer trials	1	1
	2	Selection of fabrics for mill production runs with market research assistance		
	3	Progress report		
		Sub Total		1

ANNEXURE-I (cont'd)

Stage	Main Activities	Duration Months	Elapsed Time Months
6 Manufacturing	1. Mill Manufacture of Selected Fabrics	6	5
	2. Supervision of Mill Finishing	2	1
	3. Supervision of Garment Manufacture	3	1
	Sub Total		7
7 Garment Field Trial	1. Consumer Acceptance-Field Trial	4	3
	2. Laboratory Evaluation Fabric and Garments. Comparison with Competitive Products - domestic/Overseas Origin	3	
	3. Establish Production/Manufacturing Costs - Liaison with Market Research	1	
	4. Evaluation of Field Trial Responses		1
	Sub Total		4
8 Market Research	1. Market Research-Home & Export Markets Market Size ( EEC ), Distribution Patterns, Tariffs Trade Restrictions Price Structures etc. Economic Assessment of Product Viabilities and Forecasted Sales	3	2
	Sub Total		2
9 R & D Planning	1. Preparation of Forward R & D Programme Inputs - Project Work - Study Tours - Market Research Recommendations	1	-
	Sub Total		-
10 Dissemination	1. Dissemination - Seminars (Commercial & Market Research Inputs) - Project Publication/Report	4	3
	Sub Total		3
Total Elapsed Time			45







ANNEXURE-II

LIST OF EQUIPMENT TABULATED IN THE PROJECT PROPOSAL

(A)	Process Development Phase	
	(1) Padding Mangle	.. \$. 26,000
	(2) Drying-Curing Ovens Continuous-Range Benz or Mathies type	.. \$. 22,000
(B)	Garment Make-up	
	(3) Hot Head Press	.. \$. 15,000
	(4) Sewing Machine(Chain Stitch)	.. \$. 3,000
	(5) Sewing Machine(Lock Stitch)	.. \$. 5,000
	(6) Garment Curing Oven	.. \$. 18,000
(C)	End-use Evaluation	
	(7) Data Storage and Analyser Calculator	.. \$. 11,000
	(8) Gel Permeation Chromatograph (Preparatory Pyrolysis)	.. \$. 20,000
	(9) Mini-graph Catalog Duplicator The Star System Saxon 301 Rank Zerox	.. \$. 14,000
		<hr/>
	Total	.. \$.134,000

All the equipments need to be provided to the project staff during the first year of the project, as these will be required for the workplan of 1983-84.

ANNEXURE-III  
 REPORTS SUBMITTED UNDER PROJECT IND/87/011  
 TO UNDP/UNIDO AND GOVERNMENT OF INDIA

Date/ Period	Title	Submitted by	Submitted to
20.10.83	Technical Report: Initial Review of Project(No.1)	T.A. Marsland	UNIDO for Government of India
17.8.84	Technical Report: Second Review of Project(No.2)	"	"
15.5.85	Technical Report: Third Review of Project(No.3)	"	"
27.2.84	Project Findings Draft Progress Report(No.1)	J.R. Modi	UNDP and Govt.of India
4.12.84	Project Findings Draft Progress Report(No.2)	"	"
7.5.85	Project Findings Draft Progress Report(No.3)	"	"
April '83 to July '88	Quarterly Progress Reports for the work carried out from January 83 to June 88 (Twenty Two Reports)	ATIRA	Govt.of India
Nov. '85 to April '87	Half Yearly Progress Reports for the work carried out from January '83 to March '87 (Eight Reports)	ATIRA	UNDP
January '84 to April '86	Status Reports for Tripartite Review Meeting (Three Reports)	ATIRA	UNDP
March '85 to June '88	Status Reports (Eight Reports)	ATIRA	Govt.of India

ANNEXURE-IV

LIST OF PUBLICATIONS

(A)

Research Notes

- (1) Easycare Finishing of Polyester-Cellulosic Blend Fabrics  
J.R. Modi and C.S. Rao  
ATIRA Research Note, CT 146/1985
- (2) Performance Evaluation of Easycare Finished Cotton and Cotton Rich Blend Shirtings  
J.R. Modi and C.S. Rao  
ATIRA Research Note, CT 156/1986
- (3) Performance Evaluation of Easycare Finished Cotton and Cotton Rich Blends - Bed Sheetings, Trousers and Dress Materials  
J.R. Modi and C.S. Rao  
ATIRA Research Note, CT 157/1986

(B)

Papers Published

- (4) Performance Evaluation of Softeners in Resin Finishing  
J.R. Modi and C.S. Rao  
Journal of Textile Association 47, (5), p.165, 1986
- (5) Formaldehyde Release in Resin Finished Fabrics- A Review  
C.S. Rao and J.R. Modi  
Textile Dyer and Printer, 19, (22), p.21, 1986
- (6) Formaldehyde Release in Resin Finished Fabrics, Some Observations  
C.S. Rao, J.R. Modi and N.C. Mali  
Textile Dyer and Printer, 20, (5), p.24, 1987
- (7) Performance Evaluation of Easycare Finished Cotton and Cotton Rich Polyester Shirtings  
J.R. Modi and C.S. Rao  
Textiles, Today and Tomorrow, published by Textile Association, Bombay, p.391, 1986
- (8) Effect of the Finishes on Dyed Fabrics  
C.S. Rao, J.R. Modi and N.C. Mali  
Colourage, XXXV, No.14, p.11, 1988

(C)

Papers sent for Publication

- (9) Evaluation of Triatex MA and High Pressure Squeeze Systems for Resin Finishing Applications
- (10) Variation in Shade in Fabrics for Garment Manufacture

ANNEXURE - V

SYNOPSIS OF PUBLICATIONS

EASYCARE FINISHING OF POLYESTER CELLULOSIC BLENDS

ATIRA RESEARCH NOTE CT/146,1985

This research note deals with easycare finishing of dilute blends of cellulosics with polyester, with an emphasis on the effect of preparatory processes on the fabric properties obtained after resin finishing.

In the first part, effect of caustic treatments, (mercerisation and causticisation) carried out on a polyester: polynosic:cotton (PPnC) blend fabric, as part of fabric preparation, on the resultant properties of the fabric on subsequent resin finishing was studied. From this study, it can be concluded that, on caustic treatments, a reduction in dry crease recovery angle, tensile and tear strengths and an increase in wet crease recovery angle takes place. Scanning Electron Micrographs of the treated fabrics confirm the chemical attack on polynosic fibres during caustic treatments. Due to the initial high values of strength and dry crease recovery angle, unmercerised PPnC fabric exhibits higher strength even after resin finishing as compared to the corresponding mercerised and causticised fabrics. It is, therefore, not advisable to give mercerisation or causticisation treatment to a PPnC blend fabric if it is required to be easycare finished subsequently.

In the second part, fabrics containing small amount of polyester with cotton as the major component (85:15 and 67:33 C:P) were evaluated for strength-abrasion properties and crease recovery angle before and after easycare finishing. Performance of these fabrics was compared vis-a-vis an all cotton fabric of identical construction and also subjected to easycare finishing. Heat setting, a process which imparts dimensional stability to polyester fibre fabrics, was carried out for the

blends with a view to evaluate the effectiveness and necessity of this process for these dilute blends. From the study, it can be concluded that heatsetting can be eliminated for cotton rich polyester blends. Further, introduction of small amounts of polyester in the fabric improves dry and wet crease recovery angles, thereby facilitating reduction in percent resin add on on the fabric to impart the same level of crease recovery angle, an index for easycare property of a fabric, after resin finishing. Due to the presence of a stronger and more resilient polyester fibre in this fabric, the blend fabric also shows higher retention of strength and abrasion properties after resin finishing, as compared to the all cotton fabric.

Annexure-V (cont 'd)

PERFORMANCE EVALUATION OF EASYCARE FINISHED COTTON  
AND COTTON RICH POLYESTER BLEND SHIRTINGS

ATIRA Research Note, CT/156, 1986

This paper deals with the performance evaluation of easycare (EC) finished shirts made from cotton and cotton rich polyester blend fabrics, vis-a-vis the polyester rich blend shirts. For the evaluation, three cotton poplins and two cotton:polyester blend fabrics (85:15 and 67:33 C:P) were resin finished prior to shirt manufacture. Two polyester:cotton blend fabrics (48:52 and 67:33 P:C) were procured from a local mill after conventional softener finish and were also converted to shirts. The evaluation process consisted of two approaches. (1) The laboratory study of different properties of fabric samples and shirts after progressive wash/dry cycles, and (2) the wearer trial to assess the performance of the shirts. Properties related to comfort were also determined.

From this study it is concluded that a dilute blend (C:P :: 67:33) fabric can perform as good as a polyester rich blend (C:P :: 33:67); if the former is treated with a crosslinking resin at a concentration of about 2% on the weight of the fabric. The other salient findings of this study are (1) easycare finished P/C shirts have good wet abrasion resistance and could withstand upto 100 wash/dry cycles without any significant signs of abrasion, (2) The easycare finished shirts show an acceptable DP rating (3 or better) upto 100 washes. (3) No correlation exists between wearer responses and laboratory evaluation, in as far as the appearance of shirts as judged by users and DP ratings are concerned. (4) In order to perform satisfactorily, an EC finished fabric should possess a minimum level of tear strength in the weft direction and (5) Performance profile ratios, obtained by computing different properties of the fabrics (both resinated and unfinished), can be used as an effective indicator to predict the performance of an easycare finished fabric.

Annexure-V (cont 'd)

PERFORMANCE EVALUATION OF EASYCARE FINISHED COTTON AND COTTON RICH  
POLYESTER BLEND BED SHEETINGS, TROUSERS AND DRESS FABRICS

ATIRA Research Note, CT/157, 1986

This research note deals with the performance evaluation of easycare (EC) finished (a) bedsheets, (b) trousers, and (c) dress materials from cotton and cotton rich polyester blend fabrics. The evaluation was carried out through (1) the laboratory study of different properties of fabric samples and garments during progressive wash/dry cycles, and (2) user trials to assess the performance of the garments and sheets. From this study, the following guidelines could be drawn for selection of fabric for EC finishing.

The correct fabric choice for a bedsheet fabric would be 20s/20s, 50 x 60 with a well spread small motif, so that both the strength-abrasion properties and the appearance related properties are on a higher side, with the consequent better durability and acceptance by the user. Wearer evaluation of the trousers show that EC finishing of 67:33:: C:P blend fabric has a marked advantage over the unfinished fabric, in all the respects; while for the 52:48:: C:P blend suiting fabric, no significant differences in ranking scores are seen between the finished and unfinished fabrics.

Majority of the wearers feel that a 67:33:: C:P blend dress material is comparable in performance with that of a garment made from polyester rich blends. Between cotton and blend dresses, cotton ranks lower than the blend in all the performance related properties.

Both the dress materials, i.e., trousers and dress material, do not show any correlation between wearer responses and laboratory evaluation. However, for the bed-sheets, laboratory evaluation for appearance rating and the user rankings match.



Annexure-V (cont 'd)

PERFORMANCE EVALUATION OF SOFTENERS IN RESIN FINISHING

J.Text.Association, 47 (5), 165, 1986

Resin finishing has certain drawbacks such as considerable reduction in fabric strength and resistance to abrasion. This reduction in strength and abrasion properties of the finished fabric can be improved substantially by the incorporation of a nonionic or cationic softeners in the resin pad bath. These softeners act as lubricants by imparting a more even stress distribution between the fibres. In this paper, work carried out on the evaluation of performance of polyethylene and silicone emulsions and a cationic softener is reported.

Of the three softeners studied, the cationic softener based on quaternary ammonium compound is the least effective when used in the presence of a crosslinking resin. Between silicone and polyethylene emulsions, the latter type shows better retention of fabric tear strength after repeated accelerated washes in the laboratory. Further, wet abrasion resistance of polyethylene emulsion treated samples is better than the silicone emulsion treated ones. However, accelerator weight loss of both the softener finish types are similar and do not show any significant difference.

Annexure - V (cont'd)

FORMALDEHYDE RELEASE IN RESIN FINISHED FABRICS  
Textile Dyer and Printer, 20, (5), 24, 1987

In the easycare finished fabrics, formaldehyde release is governed by a number of factors. The resin itself contains certain amount of free formaldehyde. During crosslinking reaction, cleavage of a certain amount of cross-linking agent, either in the unreacted form or single end reacted takes place, leading to the formation of free formaldehyde. The cellulosic fibre has a strong tendency to retain this free formaldehyde. When present, even at very low concentrations, formaldehyde containing fabrics can cause skin irritation. Certain adverse effects on human health is also noticed in extreme allergic cases.

The work on formaldehyde release in resin finished fabrics was divided into two parts - a review of the literature and some after-treatments to resin finished fabrics with an aim to reduce the free and cleavable formaldehyde content. A review of the available literature shows that all out efforts have been made by the synthetic chemists in preparing very low free formaldehyde or nil formaldehyde resins. Further, the finish recipe and process conditions were studied in great detail by researchers and is fairly standardised for minimum possible release of formaldehyde. On the other hand, attempts to bind free formaldehyde by addition of formaldehyde acceptors in the resin recipe or after treatment of the finished fabrics, could not be exploited in industrial scale due to their low effectivity. Amongst the various after treatments, an alkaline process wash is reported to be ideally suited.

In the second paper, effect of various after treatments on the free formaldehyde content of the resin finished fabrics was dealt in detail. In addition, effect of steaming the resinated fabric and presence of urea in the pad baths were also studied.

Of the various after treatments studied, a process wash with sodium carbonate is found to be the best. Steaming of the resin finished fabrics reduces the free formaldehyde content of the fabric, to a level, significantly lower than that obtained by the unwashed fabric. However, steaming is not as effective as the alkaline afterwash. Addition of urea to the pad bath also significantly reduces the formaldehyde release, though to a lesser extent than the process wash.

EFFECT OF THE FINISHES ON DYED FABRICS

Colourage, XXXV, No.14, p.11, 1988

Resin finishing process is known to have an influence on the shade of the dyeings or the whiteness of bleached fabrics. The extent to which dye fastness or tone of dyeings change on finishing is decided by the type of dye, dye application method, type of resin and catalyst, other additives in the finish recipe and the method of finish application, fixation and aftertreatments. Direct and reactive dyes are known to show changes in shade and a reduction in light fastness property after resination. Presence of catalyst and softeners in finish recipe greatly influence the final results obtained, as by and large, resins and finish application method are standardised and contribute to a small extent only. The present paper deals with the changes brought about on dyeings obtained on a cotton poplin fabric, after resin finishing as well as conventional softener finishing. For this study, three classes of reactive dyes (4 dyes from each) and 4 dyeings from Azoics type were produced and evaluated for the effect of finish on the dyeings.

From this study, the following conclusions can be drawn:

1. Both the resin finishes and the conventional softener finish change the tone of the dyed fabric. The extent of variation in tone with any type of finish is dye specific.
2. Shade of finished fabric is retained to a large extent even after ten laboratory wash/dry cycles. On the other hand, the dyed fabric shows substantial tonal variations at the end of the washes. Resin finishes do not impart any tonal variations other than of that order produced by a conventional finish.
3. Barring a few dyes, in most of the dyeings, wash and rubbing fastness show an improvement after resin finishing.
4. For the dyes taken in this study, light fastness is dye specific and the finish ingredients have little or no effect on this property.

AN EVALUATION OF TRIATEX MA AND HIGH PRESSURE  
SQUEEZE SYSTEMS FOR RESIN FINISHING APPLICATION

(Sent for Publication to J.Text.Association)

The effectiveness of Triatex MA and HP Squeeze systems for fabric finishing is evaluated in this paper. For comparison, conventional padding technique was also carried out. To evaluate the controlled application of a finish onto the fabric, resin finishing was done on a cotton poplin fabric as this type of finishing can be assessed in more quantifiable terms than the conventional starch-softener finish recipes. Secondly, uniformity of resin finishing, a prerequisite for better performance of the fabric, can be predicted with a fair degree of accuracy from the measurement of strength-abrasion and resilience properties of the finished fabric.

The data obtained indicate that both Triatex MA and HP squeeze systems of finish application give better results than the conventional padding. Between Triatex MA and HP Squeezing, no significant difference is observed as seen by the levels of various properties of the finished fabrics. Triatex MA suffers from the high cost of the equipment and the necessity to have instantaneous and very uniform absorbency of the base fabric. This technique, therefore, will not be well suited for the Indian industry.

With the introduction of HP Squeeze systems for sizing of warp sheets, which are working satisfactorily and give a wet pickup of 50% on cotton yarns, scope exists for changeover to HP squeeze systems from conventional padders.

Vacuum extraction is a simple technique and unlike the other two low pick up techniques, this method requires an investment of only about Rs.3 lacs. Further, due to the simplicity of operation and low maintenance expenses and care, it is expected to gain popularity in our country in the near future.

## VARIATION IN SHADE IN FABRICS FOR GARMENT MANUFACTURING

(Sent for Publication in Colourage)

The requirements of a garment manufacturer, who procures the fabric from the processor are (i) continuous length of defect free fabric, and (ii) fairly uniform whiteness or colour of the dyed fabric for the entire batch length. The general feeling among the garment manufacturers of our country is that the fabrics do not possess uniform whiteness or shade for the full batch. Due to this limitation, they have to take extra care at cutting, assembly and inspection stages. In order to study the order of differences normally prevailing in our fabrics, a number of fabric samples, of different depths and shades, were collected from a leading apparel manufacturing plant. These samples were collected at the cutting stage, wherein 100-200 layers of fabric are spread and the parts forming the garment are cut. All these samples were evaluated on ACS Colour Control System for colour strength, overall colour difference and pass/fail analysis by 555 shade sorting method. An attempt has also been made to lay down tolerance limits for differences in colour strength and tone of the shade for a fabric to be accepted for conversion into a garment.

From the detailed study conducted, it can be concluded that substantial variation exists in dyed fabrics, drawn from one dyeing batch. Detailed analysis of Green samples drawn from the centre of the fabric width and both the selvages shows that the batch exhibits fairly large variations in depth and tone not only for different layers of the fabric laid but also from centre to selvages. In the second part of the work, four shades were evaluated for layer to layer variations by drawing about 50 samples for each shade. Substantial differences in colour strength exist in both light and dark shades. In 555 shade sorting, the percentage of samples within the tolerance limits, for passing the shade, ranges from as low as 40 to 64 percent. In our

Appendix-V (cont 'd)

country, majority of the fabric is dyed on jigger, a batch dyeing machinery. The major limitation of jigger dyeing, is its inability, in most<sup>of</sup> the cases, to impart uniform dyeability (both in colour depth and tone) to the fabric being processed. Jigger dyeing process suffers from the following inbuilt disadvantages - Ending, Tailing, Listing, Warpway streaks and stripes, Moire effects and Face back effects. Some of these can be overcome while certain others - especially tailing and ending - cannot be completely overcome, as these are inherent in the jigger dyeing process. However, good scope exists for reducing the order of observed differences in colour value by a systematic study of material handling, process control, dyestuff selection and machine maintenance.