Textiles & Clothing Department

SMT. J. D. BIRLA INSTITUTE

11 Lower Rawdon Street, Kolkata 700 020

TC SEMINAR 2003

Theme : CURRENT CHALLENGES IN TEXTILE PROCESSING

Date : Saturday, February 1, 2003

SEMINAR PROCEEDINGS

Sponsored by **DyeChem International**

'Elgin Chambers' 1 A, Ashutosh Mukherjee Road, 4th Floor, Kolkata - 700 020

TC SEMINAR 2003

Theme: Current Challenges in Textile Processing

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PROCEEDINGS

Edited by

Deepali Singhee

Textiles & Clothing Section

Department of Home-Science

SMT. J. D. BIRLA INSTITUTE

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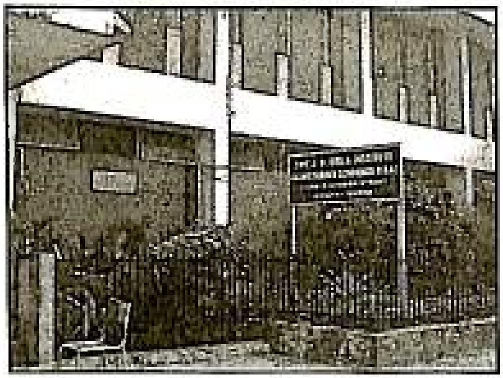
SMT. J. D. BIRLA INSTITUTE

FOUNDED IN MEMORY OF

SMT. JAWAHARI DEVI BIRLA

Institute Premises: 11 Lower Rawdon Street, Kolkata 700 020
Registered Office: 108-109 Southern Avenue, Kolkata 700 029



ABOUT THE INSTITUTE

The vision and foresight of late Smt. Sushila Devi Birla, wife of Late Shri L. N. Birla led to the establishment of Smt. Jawahari Devi Birla Institute of Home-Science in 1962. The ensuing 40 years have seen the institute make pioneering strides in the field of education. Imparting quality and holistic education to its students has always been its guiding mission; growth and development have been its foci.

While the initial years saw consistent achievements in **Home-Science Education**, the year ~~1996~~ 1997 saw the establishment of its **Department of Commerce.** In 2002 the **Department of Business Administration** was founded and now the institute was rechristened as **'Smt. J. D. Birla Institute'**. It exists today as a full-fledged institution providing graduate, post-graduate and doctoral degrees, with affiliation to the **highly accredited Jadavpur University of Kolkata.**

The Institute boasts of a well-designed campus with spacious classrooms, laboratories equipped with the most-modern equipments, an audio-visual studio, two state-of-the-art computer training centres (for undergraduate and postgraduate levels), EDP units, and three departmental libraries with classic collections of books, journals and periodicals.

The dedicated teaching staff guides and trains the students at the most personal level, and this is facilitated by an impressive teacher-student ratio. Emphasis is laid upon hands-on experience in the practical classes along with intense classroom sessions. Regular assignments, projects and seminars help the students in self-analysis and appraisal, while also providing additional motivation for greater performance. Frequent educational visits to social, educational, technical and commercial centres help gain valuable experience, while the visiting faculty from vocational and academic fields provides the much-needed in-depth knowledge of the complex areas of the curricula.

Necessary revision of the curricula/syllabi is done periodically to keep them at par with the international standards of education and to conform to the emerging attitudes, environmental factors and living patterns.

The education program is complemented with co-curricular activities such as debates, quiz, dramatics and sports to ensure the all-encompassing development of the young students.

DEPARTMENT OF HOME-SCIENCE

With the change in attitude towards women's education and with the increasing importance placed upon job-oriented and practical everyday knowledge, this field of the Applied Sciences is considered essential. Home-Science education is geared to meet the emerging needs and challenges of the contemporary society through proficiency and training in sciences, arts and humanities, all blended together to improve the general quality of life.

Its interdisciplinary approach synthesizes knowledge drawn from physical, biological and social sciences and the arts. The education program places its primary objective in the necessity to provide and encourage a living which is best adapted to interaction with environmental forces. The major areas of specialization of the main discipline of Home-Science include Textiles & Clothing, Resource Management, Food & Nutrition, Human Development and Composite Home-Science. Foundation knowledge for these diverse fields is created with various pure science and humanities subjects such as Physics, Chemistry, Physiology, Psychology, Biochemistry, Economics, Sociology, Culture & Heritage of India and Art in Everyday Life.

AREAS OF SPECIALIZATION

Textiles & Clothing

This field focuses on several features related to the Textile and Apparel industry; some key areas being Textile Processing, Textile Construction and End-use Patterns. Training in Marketing and Merchandising in textiles and its ancillary areas brings in the much-needed commercial aptitudes. Fiber Science, Fabric Manufacture, Textile Testing & Chemistry, Textile Processing, Traditional Textiles & Costumes of India, Pattern Making, Textile Crafts and Textile Design are some subjects studied here.

Resource Management

This covers the various aspects of resource management for a group - family, business, institution and others, for need-satisfaction of its members and efficient adjustment to the ever-changing environment. While carrying out the in-depth studies of all available human and non-human resources, emphasis is laid upon efficient decision-making in the management of the valuable resources of time, money and energy. Institutional Management, Ergonomics, Work & Work Environment, Consumer Education, Financial Management, Interior Design and Hospitality Management are some significant subjects here.

Food & Nutrition

The overall objective of Food & Nutrition is to impart knowledge about the relationship between food and health, and to familiarize students in subjects like Basic Nutrition, Nutritional Biochemistry, Food Analysis, Microbiology, Food Preservation and Food Preparation. Special emphasis is given to Child Nutrition and Community Nutrition.

Human Development

This field has evolved into a highly scientific discipline with emphasis being laid on Child Psychology, not merely for physical development but also for a well-defined and healthy development of the child's mental, emotional and intellectual fibres. Emphasis is placed upon pediatrics, behavioural patterns as well as different methods of rearing. The program also covers the education and rehabilitation of exceptional children and the development of creative talents.

Composite Home-Science

This is a well-balanced framework of the above four specialization areas – Textiles & Clothing, Resource Management, Food & Nutrition and Human Development. As a comprehensive program, this specialization equips the students towards a wider and generic application of the knowledge of Home-Science.

RESEARCH ACTIVITIES

Every post-graduate student (Resource Management, Human Development, and Composite Home-Science) is actively involved in research work for the preparation of a dissertation which constitutes a significant part of the grading system. Post-graduate teachers and the visiting faculty provide expert guidance. Advanced equipment and special facilities are made available for this purpose. Further, the faculty and ex-students are involved in active departmental research.

SCOPE OF HOME-SCIENCE

Knowledge acquired from the various fields of Home-Science gears up the students to cope with varied situations in personal family life; on the professional front it affords a wide scope of vocations in the following areas -

- Research at universities and research centres in the areas of food evaluation, textile analysis, human development and others.
- Laboratory supervision and analysis for the food industry and at textile laboratories.
- Private entrepreneurship in nutrition consultancy, restaurants, interior designing & decorating, dyeing & printing, tailoring and artifact designing.
- Consumer Counselling.
- Teaching at Home-Science and Agricultural schools and colleges.
- Administration and supervision at Child Guidance Clinics.
- Diet planning as dieticians at hospitals, nursing homes and industrial canteens.
- Interior designing and decorating at private and commercial establishments.
- Housekeeping and supervision at hospitality centres like hotels and hospitals.
- Social and community work with governmental and voluntary agencies.

DEGREE PROGRAMS IN HOME-SCIENCE

The institute offers the following degree courses:

- **B.Sc. (Honours) in Home-Science** *(Three years)*

Preliminery & Part I - Foundation Subjects
Part II - Specialization in any one of the following:
(depending on preference and aptitudes)
* Textiles & Clothing
* Resource Management
* Food & Nutrition
* Human Development
* Composite Home-Science

- **B.Ed. in Home-Science** *(One year)*

- **Post Graduate degrees** *(Two years)*
  * M.Sc. in Resource Management
  * M.Sc. in Human Development
  * M.Sc. in Composite Home-Science

Ph.D. Programmes *(Five years)*
* Human Development

DEPARTMENTS & FACULTY MEMBERS

(Department of Home-Science)

TEXTILES & CLOTHING

Ms. Deepali Singhee, M.Sc. (Textiles & Clothing), *Lecturer* *
Ms. Samita Gupta, M.Sc. (Textiles & Clothing), *Lecturer* *
Ms. Debanjali Kabiraj, M.Sc. (Textiles & Clothing), *Lecturer* *
Ms. Malavika Lohia, B.Sc. (Textiles & Clothing), *Part-time Faculty*

FOOD & NUTRITION

Ms. Lilu Mancha, M.Sc. (Food & Nutrition), *Lecturer (Selection Grade)*
Ms. Shivarati Bose, B.Ed., M.Sc. (Food & Nutrition), *Lecturer* *
D.. (Ms.) Bharti Mukherjee, Ph.D (Bio-Chemistry), *Ex-Reader*
Ms. Indrani Biswas, B.Sc. (Food & Nutrition), Diploma in Dietitics, *Lecturer*
Ms. Vineeta Roy, M.Sc. (Composite Home-Science), *Lecturer* *
Ms. Payal Bhatia, M.Sc. (Composite Home-Science), *Part-time Faculty*

RESOURCE MANAGEMENT

Ms. Komal Sharma, M.Sc. (Home Management), *Lecturer (Selection Grade)*
Ms. Kusum Musaddi, M.Sc. (Home Management), *Lecturer (Selection Grade)*
Ms. Sonia Gupta, M.Arch (Housing), *Senior Lecturer*
Ms. Ushashi Hazra, M.Sc. (Family Resource Management), *Part-time Faculty*
Ms. Ratna Pututunda, B.Sc. (Family Resource Management), Diploma-EXIN, *Part-time Faculty*

HUMAN DEVELOPMENT

Ms. Krishnakali Bhattacharya, B.Ed., M.Sc. (Psychology), *Lecturer* *
Ms. Pitambari Bagla, M.Sc. (Human Development), *Lecturer*
Ms. Parul Seth, M.Sc. (Human Development), *Lecturer*
Ms. Poonam Mehra, B.Ed., M.Sc. (Child Development), *Lecturer* *
Ms. Shradha Agarwal, M.Sc (Human Development), *Part-time Faculty*
Ms. Malabika Bose, M.A. (Sociology), *Part-time Faculty*

COMPOSITE HOME-SCIENCE

Ms. Smita Parekh, M.Sc. (Composite Home-Science), *Lecturer*
Ms. Shaila Jassal, B.Ed., M.Sc. (Composite Home-Science), *Lecturer* *

OTHERS

Dr. (Ms.) Krishna Majumdar, PhD. (Organic Chemistry), *Reader*
Dr. (Ms.) Gita Zutshi, MBBS, *Senior Lecturer*
Dr. (Ms.) Bipasha Chakraborty, PhD. (Physics), *Lecturer* *
Dr. (Ms.) Soma Dasgupta, M.A. (Statistics), PhD. (Economics), *Lecturer*
Ms. Amita Dutta, M.Fine. (Art), *Lecturer* *
Ms. Tanima Mazumdar, (Art), *Part-time Faculty*
Ms. Suma Saha, (Art), *Part-time Faculty*
Ms. Rupashree Dutta Roy, (Physiology), *Part-time Faculty*
Ms. Sharmistha Sinha Roy, (Adult & Non-Formal Education), *Part-time Faculty*
Ms. Jaya Masand, (Extension Education), *Part-time Faculty*
Ms. Nita Dujari, (Extension Education), *Part-time Faculty*
Ms. Sharbani Banerjee, (English & Mass Communication), *Part-time Faculty*
Ms. Suchismita Das, (Psychology), *Part-time Faculty*
Ms. Taniya Basu, (Computer Fundamentals), *Part-time Faculty*
Ms. Anita Das (Applied Psychology), *Part-time Faculty*

** NET-Qualified*

B.SC. (HONS.) IN HOME-SCIENCE

(WITH SPECIALIZATION IN TEXTILES AND CLOTHING)

CURRICULUM

All subjects are compulsory in the first year. At the end of the first year, B.Sc. Preliminary University Examinations are held.

During the second year, all the subjects, except Applied Sciences, are compulsory. Applied Sciences are offered to only those students who have an aptitude for Food & Nutrition, Textiles & Clothing, and/or Resource Management. At the end of the second year, B.Sc part I University Examinations are held.

The students then branch out to their respective specialization areas in the final year, and at the end of the third year, B.Sc.(Hons.) Final University Examination are held.

B.Sc. Preliminary in Home-Science

Paper	Subject	Type	Marks
I	Basic Physics	Theoretical	50
II	Basic Chemistry	Theoretical	50
III	Physics & Chemistry	Practical	50
IV	Physiology	Theoretical	50
V	Psychology	Theoretical	50
VI	Physiology & Psychology	Practical	50
VII	Computer Fundamentals	Practical	50
VIII	Art in Everyday Life	Theoretical	50
IX	Art in Everyday Life	Practical	50
X	Human Development (Infancy & Childhood)	Theoretical	50
XI	Principles of Resource Management	Theoretical	50
XII	Introduction to Food & Nutrition	Theoretical	50
XIII	Food & Nutrition	Practical	50
XIV	Introduction to Textiles & Clothing	Theoretical	50
XV	Textiles & Clothing	Practical	50
		Total	800

B.Sc. Part I in Home-Science *(for Textiles & Clothing)*

Paper	Subject	Type	Marks
I	Applied Physics	Theoretical	50
II	Applied Chemistry	Theoretical	50
III	Physics & Chemistry	Practical	50
IV	Economics & Statistics	Theoretical	50
V	Sociology	Theoretical	50
VI	Ecology & Environment	Theoretical	50
VII	Cultural Heritage of India	Theoretical	50
VIII	Human Development (Adolescence & Adulthood)	Theoretical	50
IX	Housing & Interior Design	Theoretical	50
X	Housing & Interior Design	Practical	50
XI	Meal Management	Theoretical	50
XII	Meal Management	Practical	50
XIII	Textile Science	Theoretical	50
XIV	Children's Clothing	Practical	50
XV	Extension Education in Home-Science	Theoretical	50
XVI	Extension Education in Home-Science	Practical	50
		Total	800

B.Sc. Final *(Textiles & Clothing)*

THEORY PAPERS (with their basic objectives) **MARKS**

I. Advanced Fibre Science **50**

To impart knowledge on the manufacturing, chemical composition, properties and end-uses of natural and man-made textile fibres.

II. Yarn & Fabric Manufacture **50**

To aquaint the students with the manufacture and characteristics of different yarns, understanding of different methods of fabric construction, as well as characteristics of different fabrics in terms of their specific end-uses.

III. Textile Chemical Processing **50**

To impart basic knowledge about the different operations (dyeing, printing and finishing) involved in textile processing with detailed emphasis on the routine mill finishing, dyes & allied auxiliaries used, and to create an awareness regarding the existing effluent disposal problems.

IV. Textile Testing (Physical & Chemical) **50**

Quality of a fabric depends on its components - this subject helps to teach the methods of testing fabric components (fibre and yarn) and assess fabric properties.

V. Textile Economics and Merchandising **50**

To make the students understand the marketing concepts, problems and prospects of the Indian textile industry in order to become better consumers of textile goods.

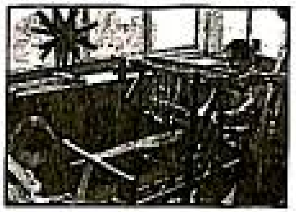
VI. Traditional Textiles of India **50**

Traditional woven & printed textiles of India are considered to be pieces of art. They are popular for the intricacy of the artistic skills of the artisans. This subject deals with their method of manufacture, materials used, designs/ motifs, colour and social significance of the textiles of India.

PRACTICAL PAPERS (with their basic objectives) **MARKS**

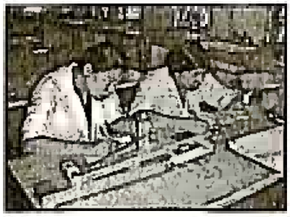
I. Fabric Manufacture **50**

* Learning how to operate the different parts of a loom and to analyse the construction and characteristics of different fabrics and weaves.



II. Textile Chemical Processing **50**

* Developing skills in dyeing , printing and finishing of textile using different dye classes and printing methods.



III. Textile Testing (Physical and Chemical) **50**

* Becoming aware about the importance of purity of a chemical used in textile processing and evaluating physical and chemical properties of textile fibres and fabrics.

IV. Traditional Embroideries of India **50**

* Learning different hand embroidering techniques with special reference to the Indian traditional art .

V. Advanced Pattern Making **50**

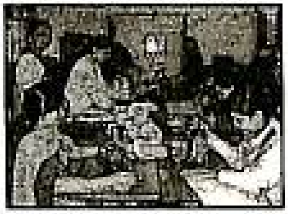
* Developing skills in principles and techniques of pattern making, and developing interest in designing various garments using different styles.

VI. Advanced Clothing Construction **50**

* Acquiring skills in handling different fabrics and stitching different apparel wear.

VII. Fashion and Textile Design **50**

* Developing skills in fashion wear designing and development of weave/print designs together with acquiring basic knowledge on computer related design software.



VIII. Textile Craft **50**

* Developing creativity by learning various craft techniques for household use.

Career Opportunities

B.Sc. (Hons.) in Home-Science:

- Freelancers in designing / garment manufacture
- Sales & Marketting personnel in stores / boutiques
- Quality Control Managers in textile mills / warehouses / export houses

M.Sc. In Textile & Clothing

- Research Assistance / Scholars
- Sales & Marketing personnel in stores / boutiques
- Purchase Managers in departmental stores
- Freelance Designers
- Academicians
- Quality Control Managers in textile mills / warehouse / export houses
- Textile Consultancts
- Entrepreneurship in Cottage Industries
- Project Officers / Co-ordinators

B.Ed. & M.Phil, in Textile & Clothing

- Researchers
- School Teachers
- Lecturers in Colleges / Universities

HIGHLIGHTS

Textile Quality Consciousness

Textile Colour Matching

Identification of various Textiles

Designing of Prints & Weaves

Tailoring of Patterned Garments

Applying Textile Policies for Exports

Comprehensive knowledge on handcrafted Textile Products

Comprehensive knowledge of Traditional Textiles of India

Dyeing & Printing of Textiles

Comprehensive knowledge of varied Fabrics

ORGANISING COMMITTEE

Convener	*Coordinator*	*Coordinator*
Deepali Singhee	**Samita Gupta**	**Dr. (Mrs.) K. Mazumdar**

Registration Committee

TEACHERS	STUDENTS		
Ms. Debanjali Kabiraj	Minal Bardia	Sumana Paul	
Ms. Krishnakali Battacharya	Aruna Goel	Garima Jain	
Nafees Ansari	Shruti Agarwal		

Reception Committee

TEACHERS	STUDENTS
Ms. Pitambari Bagla	Deepika Kedia
Dr. (Ms.) Krishna Majumdar	Ruchita Kedia
Dr. (Ms.) Bharti Mukherjee	Urvashi Baid
Dr. (Ms.) Soma Dasgupta	

Welcome Committee

TEACHERS	STUDENTS	
Ms. Smita Parekh	Anuja Choraria	Puloma Basak
Dr. (Ms.) Gita Zutshi	Suchaita Suri	Ipshita Chatterjee
Ms. Sonia Gupta	Palabi Shikdar	Suchitra Raghavan

Hospitality Committee

TEACHERS	STUDENTS		
Ms. Samita Gupta	Zainab Rangwala	Jharna Nagar	Priyanka Benjamin
Ms. Lilu Mancha	Meenal Khowala	Sucheta Mullick	Srelekha Das
Ms. Komal Sharma	Tiyona Ghosal	Sushma Jaiswal	Jinia Banerjee
Ms. Shivarati Bose	Chitrangada Gayen	Aruna Soni	

Public Relation Committee

TEACHERS	STUDENTS
Ms. Shaila Jassal	Bindiya Lalwani
Dr. (Ms.) Bipasha Chakraborty	Pooja Parasrampuria
Ms. Nipa Thacker	
Ms. Deepali Singhee	

Publication Committee

TEACHERS	STUDENTS
Ms. Deepali Singhee	Namrata Sureka
Ms. Amita Dutta	Renu Sharma
Ms. Kusum Musaddi	

Decoration & Exhibition Committee

TEACHERS	STUDENTS	
Ms. Amita Dutta	Radhika Poddar	Jignasha Hariyani
Ms. Smita Parekh	Rosy Teng	Neelam Agarwal
Ms. Malavika Lohia	Sukanya Auddy	Rituparna Nandi

PROGRAMME SCHEDULE

Registration (08:30 am to 10:00 am)

Inaugural Session (10:00 am to 10:45 am)

- Address by **Dr. (Mrs.) Jharna Sengupta,**
  Principal, Smt. J. D. Birla Institute
- Welcome Song
- Address by **Sri Amarnath Choudhary,**
  President, Indian Rayon & Industries Ltd. (Unit: Jayshree Textiles)
- Address by **Prof. Ashoke Ranjan Thakur**
  Pro-Vice-Chancellor, Jadavpur University
- Vote of Thanks

High Tea (10:45 am to 11:15 am)

Technical Session I (11:15 am to 01:15 pm)

Chair Person: Dr. A. K. Samanta
Asst. Professor, IIT (Kolkata)
Time Keeper: Ms. Anita Jain
Student - Smt. J. D. Birla Institute

- 'Development in Textile Chemical Auxiliaries'
  Mr. Deepak Bhattacharya, (11:15 am to 11:30 am)
  General Manajer, Dye Chem International, Kolkata
- 'Development in Chemical Processing of Jute'
  Dr. T. K. Guha Roy, (11:30 am to 11:50 am)
  Dep. Director, Incharge-Chem. Pro. & Prod. Develop^{n} Div., (JIRA)
- 'Globalisation : Its impact on Readymade Garment Industries of West Bengal'
  Dr. K. N. Chatterjee, (11:50 am to 12:15 pm)
  Registrar, West Bengal Council of Technical Education
- 'Printing of Silk and other Textiles with Natural Dyes'
  Ms. Darshan Shah, (12:15 pm to 12:35 pm)
  Director, Weaver's Studio
- 'Recent Development in Dyeing of Jute'
  Dr. N. C. Pan, (12:35 pm to 01:00 pm)
  Senior Scientist, Chemical & Bio-Chemical Division (NIRJAFT)

Discussion (01:00 pm to 01:15 pm)

Lunch (01:15 pm to 02:00 pm)

Technical Session II (02:00 pm to 04:00 pm)

Chair Person: Dr. K. N. Chatterjee,
Registrar, West Bengal Council of Technical Education
Time Keeper: Ms. Abha Ruia
Student - Smt. J. D. Birla Institute

- 'Challenges in Wet Processing of Microdenier Polyster Fabrics'
  Dr. A. K. Samanta, (02:00 pm to 02:30 pm)
  Assistant Professor, Textile Chemistry Section (IJT)
- 'Some Practical approaches to Chemical Processing of Cotton and Cotton / Polyester Fabrics'
  Dr. N. C. Som (02:30 pm to 03:00 pm)
  Advisor, Application Textile Research (IJIRA)
- 'Effect of Treatment with some Surfactants on Reactive Dye dyed Cotton Fabric'
  Mrs. Smita Parekh, (03:00 pm to 03:30 pm)
  Lecturer, Textiles & Clothing Department,
  Smt. J. D. Birla Institute
  Ms. Sunanda Mitra,
  Ex-Student, Post Graduate in Composite (Home-Sc.)
  Smt. J. D. Birla Institute
  Discussion (03:30 pm to 04:00 pm)

Valedictory Session (04:00 pm to 04:30 pm)

- Summing up by Convenor, TC Seminar 2003
  Ms. Deepali Singhee,
  Lecturer, Textiles & Clothing Department,
  Smt. J. D. Birla Institute
- Address by Sponsor, M/s. Dye Chem International,
  Mr. Sushil Jain,
  Director, Dye Chem International
- Vote of Thanks
  Dr. (Mrs.) K. Majumdar,
  Reader, Chemistry, Smt. J. D. Birla Institute

Tea (04:30 pm to 05:00 pm)

SPEAKERS

1. **Dr. N. C. Pan**
   Senior Scientist
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2. **Dr. T. K. Guha Roy**
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3. **Dr. N. C. Som**
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   Formerly Head, Chemical Processing Division
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4. **Dr. A. K. Samanta**
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6. **Dr. K. N. Chatterjee**
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   West Bengal State Council of Technical Education
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   E-mail : kncknckne@hotmail.com
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7. **Ms. Smita Parekh**
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   E-mail: jdbirla@cal2.vsnl.net.in

8. **Mr. Deepak Bhattacharya**
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   Dye Chem International
   Elgin Chambers, 4th floor
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   Fax : 2474 4317
   E-mail : dyechem@cal2.vsnl.net.in

9. **Ms. Darshan Shah**
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CONTENTS

GLOBALISATION: ITS IMPACT ON READYMADE GARMENT INDUSTRIES OF WEST BENGAL

K. N. Chatterjee
Registrar
West Bengal State Council of Technical Education
P- 12 Darga Road, Kolkata 700 017

Abstract

Globalisation and Liberalisation that is occurring in the whole world trade has started a mixed response in the minds of the local garment industry people. Some are of the opinion that beyond 2005 A.D. there will be a huge market available for the Indian Apparel Industries. On the other hand, others are of the opine that after the phasing out of the quota system, the Indian garment industry, especially the West Bengal Readymade Garment industries will suffer a great loss. This paper deals with the SWOT analysis of the Readymade Garment Industries (RMG) of India vis-à-vis West Bengal scenario.

1 INTRODUCTION

The strengths of the garment industry are its flexibility in producing fibres and blends at reasonable prices; India being the largest producer of jute, 2nd largest for silk, 3rd largest for cotton and 5th largest for synthetics; price competitiveness, wage-cost competitiveness, capabilities in design development are its rich heritage. India is one of the emerging powers in the increasing global clothing supply chain.

The weaknesses lies in high cost of the corporate; limited product range at the lower end of the markets, high degree of fragmentation, inadequate support of HRD and inadequate economies of scale.

The Indian Textile and Garment industries can become more competitive with the rest of the world without the need for miracles. Full use of the new technologies, the realization that fibre manufacturing, textile manufacturing, garment and retail marketing are not separate business, but must operate as parts of an integrated consumer responsive supply system, are the essential ingredients for success.

The Textile and Garment sector as a whole is second only to agriculture, accounting for 20% of our industrial production and employing an estimated 93 million people. Government statistics suggests that there is around 60,000 garment factories employing about 25 million people in this activity. Exports of Textile and Garments earn about

1/3rd of India's foreign exchange every year. Export of Textiles and Garments from India totaled over $11.00 billion (Rs. 57737 crores) for the year 1999-2000, out of which garment export valued about $6.0 billion making the garment industry the first largest export sector of India. There has been an increase of about 9.3% export growth by terms of value in the year 1999 - 2000 as compared to the previous year. Moreover, garment export from India represent only about 3% of global trade, and the unit value realization has been around $4.0. The share of woven and knitted garment is almost equal at 50% each, in volume terms.

India's garment export performance is not one of its best phases. On top of it, the country is heading for a free trade and a quota free regime by 2005, a target not far away. Thus, the next 3-4 years are going to be extremely critical for the garment industry to re-build its base and execute its strategy to attain a rising growth trend once again, although opportunity and tremendous potential does exists.

One of the key concerns in future is the phasing out of garment quotas by 2005, making the developed countries as non-quota market, which provides ample opportunities for the Indian Textile and Garment Industry; the developed nation will vacate such labour intensive garment industry and will import the product from the developing nation.

Challenges and changes are not new to the textile and clothing industry, for each decade has ushered in fresh challenges that have evoked an appropriate response. The path to progress has been shaped by capacity for rapid adaptation to change, allied with innovative research and development.

The Apparel Export Promotion Council (AEPC), Ministry of Textiles, Government of India has fixed a realistic target so that India's garment export reach to $ 9.0 billion by the year 2004-2005, enhancing about 10% of global share of trade. Considering immense possibilities of garment industry in the West Bengal State we should target at least 1% share out of 10% of global share.

2 INDUSTRIAL POTENTIAL AT WEST BENGAL

Based on the Arthur D Little report on Vision of West Bengal's industrial future, Strategic Prospective Confederation of Indian Industry (CII) embarked on a unique programme to conduct industrial potential survey to facilitate industrialization of the backward districts of the state.

The objectives of such an industrial profile study was to:

i) Undertake a thorough study of a particular district in terms of its locational advantages and infrastructural facilities available and

ii) Shortlist feasible industrial projects for investors to invest in, based on the above and with a view to develop these districts.

This study projected West Bengal as the most rapidly developing industrial region with a competitive environment and as a home to some of India's most competitive industries. It also forecasted the growth of Calcutta as a leading industrial, trading and service sector and the undisputed gateway to the Asia Pacific Industries.

The Arthur D Little and his consulting team surveyed a series of industrial clusters of importance in the State of West Bengal and identified garment manufacturing as one of the major industrial clusters with strong development potentials. Based on the Arthur D Little Report, the West Bengal Government and CII constituted a Joint Taskforce whose basic objective is to promote investments and economic activities in West Bengal.

3 PRESENT SCENARIO IN WEST BENGAL

The government of West Bengal is now making good business relations with developed nations (like Japan, EU, Asia and Oceania, etc.). Strides are also been taken by the government to attract investors from both abroad and within India. The Garment industry will ensure the only area where investment with in India will come in, with our sincere efforts.

West Bengal state has suffered due to a comparatively poor response from investors in the development of garment industry. The reality is that the technology creators in the private sector respond to the need of the high-income consumers.

The main competitive advantage of West Bengal is the vast number of people. This along with political stability and widespread use of the english language, plus traditional textile craft skills, mean that West Bengal has much to offer. Industrialists may think that neighbouring countries such as China and Bangladesh are cheaper; however, low price is no longer a sufficient or unique competitive factor for companies seeking to supply to the European Union and other developed countries. Efforts are needed by the Indian industries to overcome their poor reputation in these developed markets for poor quality and slow response time.

Fashion garment manufacturing is expected to grow at a faster rate in India. Hence, West Bengal should also take part in the competition because:

i) The fashion garment manufacturing industry requires quick response and cash return is possible within few years.

ii) The garment industry is labour intensive.

iii) The garment industry does not require much fixed capital. Hence, entry is relatively easy. A new entrepreneur needs primary technology, a niche in market and some working capital.

iv) The garment industry comes under small-scale industries and such industry requires rapid development for solving unemployment.

For promoting garment-manufacturing industry in the West Bengal state, 4 critical areas, which need thrust, are as follows:

i) International quality fabric availability

ii) Skilled technical man-power

iii) Disciplined, qualified and motivated worker, who are quality conscious and ready for quick response.

iv) Infrastructure facility like CAD/CAM SERVICE CENTRE, Modern machineries, etc.

The Textile and Garment industry need more productivity experts and quality controllers. The number of top quality graduates and technicians to support the garment industry is still small compared to the size of the industry.

Skilled technicians, skilled workers and semi-skilled workers can be produced by starting diploma / certificate courses in the existing government / private polytechnic institutions, so that the garment industry grow in the state to meet the demanding need of productivity and quality standards of garments.

A CAD system is only as good (or as bad) as the designer working on it. Computer only speeds up the process of say repeat making, color changing, motif manipulation etc. It is actually the CAM aspect of CAD that will help reduce lead-time.

4 LEAPFROGGING HURDLES, GETTING AHEAD

In spite of possessing the second highest splindleage in the world next to China and being the second largest producer of silk and the third largest producer of cotton, the Indian share of world exports amounts to a measly three per cent! This is less than half that of China and almost one-third that of Hong Kong.

Obsolescence, low productivity and poor infrastructure are largely to be blamed for this. However, a bright side also exists to this picture; in recent years our apparel industry has been growing very rapidly and its seems poised to make even faster progress in the future.

Over 30,000 readymade garment units, employing three million hands and scattered throughout the country are the reason for this remarkable development.

The products of the apparel industry are largely, though not exclusively, meant for world markets. Its capability and competence is, to a large extent, dependent on fashion technology. This is where the changes are taking place, this is where the happenings are happening and Fashion Technology will provide the cutting edge here.

By the year 2005, the phasing out of the quota system will be complete. New markets have already emerged in unlikely places such as South Africa, the CIS countries and Latin America for the apparel industry: and this is bound to grow provided we don't lose our impetus!

From near-zero the fashion industry has already come far; it will have to grow further to gear up to the world standards. We will have to pull out all stops and work double-time to make the most of this opportunity.

The existing infrastructure is quite inadequate for the purpose; a new mode of knowledge-dissemination has to be found.

Learning is the key. India possesses a sword that can cleave through all barriers; only a cutting-edge has to be put on it!

5 WHAT WE REALLY NEED?

Studies show that India is slowly becoming the back-end design house for many foreign manufacturing players. The industry is witnessing a surge in back-end design work and many Indian companies are acting as design centres for players in the West.

So, while the industry has gone ahead and brought its solutions to the common man, it has been lagging behind in procuring trained manpower. While the industry has been pressing the need for more trained knowledgeable persons, the training centres have not been able to fulfill this demand.

All this has only added to the need of knowledgeable persons who can effectively utilize the CAD/CAM resources available in the organization. CAD/CAM is a major focus area for the manufacturing sector. 70 percent of international trade is through process manufacturing segment, thereby global competency in manufacturing and delivery is very crucial. Breakthrough thinking and creativity in the industry has become essential to capitalize on the globalization.

Significantly, increasing cut throat competition is pushing many business houses (especially the manufacturers), to adopt CAD/CAM tools as a means of survival. No longer are the competitive variables limited to price and functionality, delivery time and design have become essential factors for success.

6 DIFFERENCES IN THE DEMAND AND SUPPLY OF PROFESSIONALS

Potential opportunities raise the question whether we have the requisite manpower skills to match the low-end and high-end CAD/CAM requirements. The response is mixed. Statistics show that in India, we have about approx. 70,000,00 technologists, but there are only 2,300 designers per million, which in turn shows the lack of supply and generation of product designers. In spite of steps taken by visionaries like Nehru on the establishment of National Institute of Design, India has failed to take this movement down to the masses.

While the industry has been pressing the need for more designers, the training centres have not been able to fulfill this demand. The quality of CAD operators produced by the training centres varies. The need is more for CAD designers.

7 NEED FOR STANDARDIZED, CERTIFIED CURRICULUM

Another major issue plaguing the industry is the need for a standardized curriculum. The reason behind the lack of initiative is absence of knowledge among the students. The requirement is for an individual who can not only perform as a product designer from day one, but also has right kind of exposure and experience in the latest design / development oriented software and processes. The individual should have the domain knowledge of the garment industry.

Training in isolation is not enough. Either we train the existing experienced professionals from various domains or we should provide training and work experience to the fresh graduates. Today's market requires an individual to be more than an operator. The users need to think beyond the scope of application constraints and work on design as a process. Unfortunately, today's training is focused on making the student an operator of the software and not good a designer. The institutes can meet these requirements by producing candidates of good calibre who have worked on projects, and follow a certification process.

8 QUALITY—THE UNDERLYING CRITERIA

Quality is a pre-requisite in this industry. Thoughts are changing and the vendors have become stricter in their approach towards training, "We feel that there is still a need to have courses, which are independent of the software used and teaches the process of design, analysis and manufacturing."

For training in the garments technology unlike in the mechanical, civil, architectural and GIS disciplines, the industry needs courses designed for the professional and which are typically precise and intensive in order to help them quickly become more productive.

Few of the industry experts believe that the attitude of "training on the job" does not work anymore as it involves a lot of time, effort and money spent. Fashion institutions with CAD/CAM technologies should have its own validation of training, where certification might help. The need is more for a collaborative effort between the industry and institution, wherein they pool in their domain knowledge. Such resources can only be possible by creating a resource centre, which provides domain expertise, designing and engineering skills and also work experience. Firther industry oriented pilot projects can be organized to train the industry people on structured short courses on designing which will help to strengthen the industry.

9 FUTURE SCENARIO OF THE CLOTHING INDUSTRY

Information revolution promises to bring the world closer to cohesion. In the emerging face of fast moving information, technological transfer is bound to take place at a higher speed. As the international borders blur, Supply Chain Management and Information Technology take a crucial role in apparel manufacturing. Global partners in the clothing supply chain are exchanging information electronically, thus the need for Indian Clothing Industry to spruce up. Upcoming technologies for mass customization such as three dimensional non-contact body measurement and digital printing ought to be implemented fast. This mass customization shall be successful for meeting unpredictable demand levels, for luxury goods, uncertain customer wants and for heterogeneous demand. It is to be noted that mass customization is different from mass production.

The future requires generation of real value service for the customers, comprehensive study of multifaceted and multi-layered supply chain, and global integration of supply system in a cost and time effective manner. Inventory planning, sales forecasting, manufacturing strategy, distribution network and transportation management are some of the areas, which need improvement.

RECENT DEVELOPMENT IN DYEING OF JUTE

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Abstract

Jute, the golden fibre, is gaining importance day by day due to its biodegradability and eco-friendly nature. Jute with its unique versatility rightfully deserves to be branded as "The fibre for the future". World market of jute has been witnessing a steady growth in diversified/value added products with regard to high value decoratives, furnishing textiles, carpets, blankets and even apparels. To make these products more attractive to the customers/users, it is necessary to impart a series of wet chemical processing sequences viz. pretreatment, bleaching, dyeing, printing, finishing. Among the various processes, dyeing plays a very vital role to satisfy the customers/users.

Jute can be dyed with various class of dyes namely, direct dye, acid dye, basic dye, 1:2 metal complex dye, mordant dye, reactive dye, sulphur dye, vat dye and azoic colours. Among these dyes, direct dyes and reactive dyes are generally applied to jute because in this case the process of dyeing is relatively easier. For the export market, reactive dyed jute fabric is preferred due to its high wash fastness rating and eco-friendliness.Further, reactive dye can also be applied on jute at room temperature. Therefore this dye is suitable for small scale/cottage industry in the decentralised sector aimed at self-employment generation. This paper attempts to throw light on dyeing of jute with reactive dye with special reference to dye characteristics, applications, after treatments, evaluation and mechanism of penetration and fixation of dye inside the jute fibre.

1 INTRODUCTION

Jute, a natural fibre, is available in plenty at a comparatively low cost and is grown mainly in India, Bangladesh, China, Nepal, Thailand and a few other south-east Asian countries. In India, it is mostly cultivated in the eastern region with a maximum cultivated area in West Bengal followed by Orissa, Assam, Bihar and to some extent in the Terai regions of Uttar Pradesh. Jute has many remarkable characteristics including agro-renewability, eco-friendliness, biodegradability, durability, cheapness, better tensile strength, anti-static property, low thermal conductivity, moderate moisture regain, good insulation property, good affinity towards various classes of cellulosic dyes and compatibility in blending with other allied natural and man-made fibres. Jute is a lignocellulosic fibre. The major constituents of jute are alpha cellulose (58-63%), hemicellulose (21-24%) and lignin (12-14%). Apart from that, fats, oils, waxes, protein, colouring matter (pigments) are also present in small proportions in the jute fibre. For making diversified and value added products from jute, dyeing plays a very vital role.

Dyeing means an application of dyestuff solution throughout the entire length of the textile material in such a way that a uniform colour effect is produced. Jute can be dyed with various class of dyes namely, direct dye, reactive dye, vat dye, sulphur dye, azoic colour, pigments. Jute also exhibits strong affinity towards basic dye, acid dye, 1:2 metal complex dye and mordant dye. This affinity is due to the non-cellulosic constituents present in jute and its structural peculiarities. Among these dyes, only direct dyes and reactive dyes are generally applied to jute as they are reasonably cheap and easier for application. Application of vat dyes, sulphur dyes, azoic colours and pigment colours are generally not preferred in case of jute for the following reasons : (i) high cost of application (ii) undesirable weight loss (iii) more shrinkage due to the presence of alkali in the dye bath itself (iv) poor rubbing fastness in case of azoic colours (v) feel of the fabric becomes harsh in case of pigment colour application. In this paper an attempt has been made to describe briefly the process of dyeing jute with reactive dyes.

2 DYEING OF JUTE WITH REACTIVE DYES

Reactive dyes were first introduced by ICI under the name Procion dyes in 1956 for the production of fast brilliant colours on cellulosic materials. They are valued for their brilliancy, variety of hue, exceptional versatility, high wet fastness profile, reasonable cost, easy method of dyeing and reproducibility of the dyeing results. Reactive dye is extensively used now-a-days for the colouration of jute fibre.

2.1 Dye Characteristics

Reactive dye contains chromophore, auxochrome, bridging group and fibre reactive system. It can be represented as D-B-R, where,

D = Chromophore group e.g, azo, anthraquinone, metal complex azo, phthalocyanine residue etc.

B = Bridging group eg, imino (NH)

R = Reactive system e.g, chlorotriazine, pyrimidine, vinyl sulphone, acrylamide etc.

The reactivity and other dyeing characteristics of a reactive dye are influenced by the bridging group and other substituents attached to the reactive system. The dyeing principle, based on fibre reactivity, involves the reaction of a functional group of the dyestuff with a site on the fibre to form a covalent bond between the dye molecule and the fibre.

2.2 Classification of Dyes

Reactive dyes are broadly classified into two groups :

i) Dyes reacting through nucleophillic substitution reactions.

ii) Dyes reacting through nucleophillic addition reactions.

2.2.1 Nucleophillic substitution type of reactive dyes :

These are of different types depending on the type of reactive group. For the colouration of the jute fibre, mainly three types of dyes are used.

i) Dichlorotriazinylamino type of dyes :

These are more reactive than monochlorotrazine type of dyes and require lower temperature (room temperature) and milder alkali for dyeing and fixation. These are known as cold brand reactive dyes. Procion M (ICI) dyes are used in dyeing jute.

ii) Monochlorotriazinylamino type of dyes:

These require higher temperature and stronger alkali for dyeing and fixation. These are called hot brand reactive dyes. Procion H (ICI) dyes are more used in jute.

iii) Bis-triazinyl type of dyes:

Here two reactive units are joined together. It has high exhaustion property and therefore before the addition of alkali most of the dye is absorbed by the fibre. This reduces the hydrolysis of dyes.

2.2.2 Nucleophillic addition type of reactive dyes :

i) Dyes containing vinyl sulphone group :

This class of dyes were first marketed by Hoechest under the brand name, "Remazol" dyes. The dye is marketed as sulphatoethyl sulphone form and is not reactive in this state. When the alkali is added, this dye is converted into its reactive form known as vinyl sulphone and reacts with the cellulose fibre.

ii) Dyes containing acrylamido group :

This dye is marketed as Primazine dye (BASF). It is less reactive than vinyl sulphone type.

Apart from this, some special types of reactive dyes are available.

2.3 Dyeing Mechanism

During the colouration process, the dye is first absorbed by the fibre and then reacts with the fibre either by a substituion reaction or by an addition reaction between the reactive system in the dye molecule and a suitable group present in the fibre molecule.

2.3.1 Chemical reaction for substitution type of reactive dye :

$$DX \longrightarrow D^+ + X^-$$
$$Cell - OH \longrightarrow Cell - O^- + H^+$$
$$NaOH \longrightarrow Na^+ + OH^-$$
$$Cell - O^- + Na^+ \longrightarrow Cell - ONa$$
$$Cell - ONa + D^+ + X^- \longrightarrow Cell - O\text{-}D + Na\,X$$

where, D = Dye chromophore
X = Solubilising group

2.3.2 Chemical reaction for addition type of reactive dye :

$$\underset{(\textit{Inactive form})}{Dye - SO_2 - CH_2 - OSO_3H} \xrightarrow{Alkali} \underset{(\textit{Reactive form})}{Dye - SO_2 - CH = CH_2}$$

$$Dye - SO_2 - CH = CH_2 + Cell - OH \longrightarrow \underset{(\textit{Dyed fibre})}{Dye\ SO_2\text{-}CH_2\text{-}CH_2\text{-}O\text{-}Cell}$$

$$Dye - SO_2 - CH = CH_2 + H - OH \longrightarrow \underset{(\textit{Hydrolysed dye})}{Dye - SO_2 - CH_2 - CH_2 - OH}$$

Dyeing behaviour of reactive dye is described in terms of affinity, rate of diffusion, rate of reaction of the dye with the fibre and water.

2.4 Dyeing Methods

Dyeing of jute with reactive dye consists of two steps viz. i) exhaustion of the dye ii) fixation of dye through chemical reaction. Exhaustion needs to be carried out very carefully otherwise uneven shades would be produced. The reaction can be controlled in such a way that the maximum reaction takes place between the dye and the fibre and minimum between dye and water. Dyeing method will depend upon the type of reactive dye used. In case of the jute fibre, only two dyeing methods are used viz. cold method and hot method.

2.4.1 Cold method

In this method, only cold brand reactive dyes (dichlorotriazine type of reactive dyes) are used.

Dye bath was made with dye (4% o.w.f.) keeping the material-to-liquor ratio at 1:20. The bleached jute samples were dipped into the dye bath and kept for 1 hr. with constant stirring at a temperature of 30^0 C. Glauber's salt (50 g/l) was added in portions to the dye bath after 20 minutes of circulation. After this treatment, sodium carbonate (15 g/l) was added in the same bath and kept for 1 hr. maintaining the same condition of treatment. Thereafter the dyed jute samples were washed in cold water, soaped with Ultravon JU (2 g/l) for 15 min., followed by usual washing and drying.

2.4.2 Hot method

In this method, hot brand reactive dyes are used.

Dye bath was made with dye (4%, o.w.f.) keeping the material-to-liquor ratio at 1:20. The bleached jute samples were dipped into the dye bath and kept for 1 hr. with constant stirring at 40^0C. Glauber's salt (40-60 g/l) was added to the dye bath in portions after 20 minutes of circulation. At this point, the exhaustion step was over. Next, dye fixation or reaction was carried out by adding sodium carbonate (10-20 g/l) in the same bath and continuing the treatment for 45 min. at 85-90^0C. After dyeing and fixation, the dyed samples were washed thoroughly in cold water, soap boiled for 20 min., followed by cold washing and drying.

2.5 Evaluation of Dyed Product

i) Reflectance at l max (nm), K/S value, colour strength (%) of dyed jute product can be measuredd by using computer colour matching system with relevant softwares.

ii) Wash fastness rating of dyed jute products were carried out as per IS : 3361 - 1979 and evaluated with the help of computer colour matching system.

iii) Light fastness property of reactive dyed samples were evaluated by an instrument named Weather-O-Meter using D-65 light source according to IS : 2454 - 1967.

3 CONCLUSIONS

i) Reactive dye is very popular among jute processors/industry because of its high wash fastness ratings as compared to other class of dyes which are commonly used for dyeing of jute. In the export market, colouration of jute product with reactive dye is preferred.

ii) Cold brand reactive dye is suitable for small scale/cottage industries in the decentralised sector because it does not require any kind of power for heating the dye bath.

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DEVELOPMENTS IN CHEMICAL PROCESSING OF JUTE

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Abstract

Jute possesses unique aesthetic & technical potentialities for many other textile related applications apart from its traditional usage as sacks, bags & other packaging material. Its non toxic & eco friendly nature, easy blendability with other fibres, low cost, introduction of MFA and other advantages has opened up a new market for the Jute diversified products. However, it is associated with some technical problems; poor colour fastness & drape being the most prominent, specially with reference to apparel wear. In order to overcome these problems, IJIRA has developed some technologies.

1 INTRODUCTION

Jute is annual plant of the genus, 'Corchorus' and the second largest plant fibre, next to cotton, grown entirely for fibre production. The two varieties of jute plant are, Corchorus Capsularis (white jute) and Corchorus Olitorius (tossa jute). It thrives best in moist / damp & hot climatic conditions as prevailing in Assam, West Bengal, Bihar, and Uttar Pradesh. Traditionally, jute has been used in the manufacture of sacks, bags and other packaging materials.

Jute also possesses certain unique aesthetic and technical potentialities for many important textile and craft applications as well as other diversified uses too. It is mainly due to its coarseness / hand-crafted look of jute yarns in fabrics, blending with other natural / wool or silk / viscose / synthetic fibre for production a wide range of blended / union fabrics with fresh fashion appeal which matches the texture of the scarce and costlier household "Linen", dyeable with all classes of dyes, eco-friendly / non-toxic nature, etc. Owing to these attributes, introduction of multi-fibre policy (MFA), scarcity and high price of cotton as well as inadequate outlet of existing products, many handloom and powerloom units in the informal sector have increasingly been coming forward to produce high value jute based home textiles. Commercial scale production of jute based floor covering, shopping bags, furnishings and wall hangings has opened up a new era in the field of Jute and has a great market potential.

However, the main technical problems of diversified jute products lie with its colourfastness and wear properties. As a result, the products fetch a low price in the market and it affects consumers' acceptance. These technical defects need be resolved for successful development of its end-uses. In order to meet the demand, the production base also needs be strengthened and the quality improved.

IJIRA's recent developments in bleaching, dyeing and chemical finishing have brought about a welcome changed "Gunny Bag" look of jute to home textiles in relation to shade / colour, smoothness and supple feel, washability, aesthetics, etc.

This paper deals with the chemical and physical properties, major short-comings of jute as a textile fibre and technology developed by IJIRA for resolving these technical constraints.

2 CHEMICAL PROPERTIES OF JUTE

Chemically, jute is a ligno-cellulosic fibre. It is mainly composed of holo-cellulose and lignin; minor components such as wax, pectin, nitrogenous substance, inorganic salt and colouring matter which occur in very small proportions (Fig.1). The holo-cellulose or total carbohydrate fraction of jute is made up of α-cellulose or true cellulose and hemicellulose.

2.1 α-cellulose

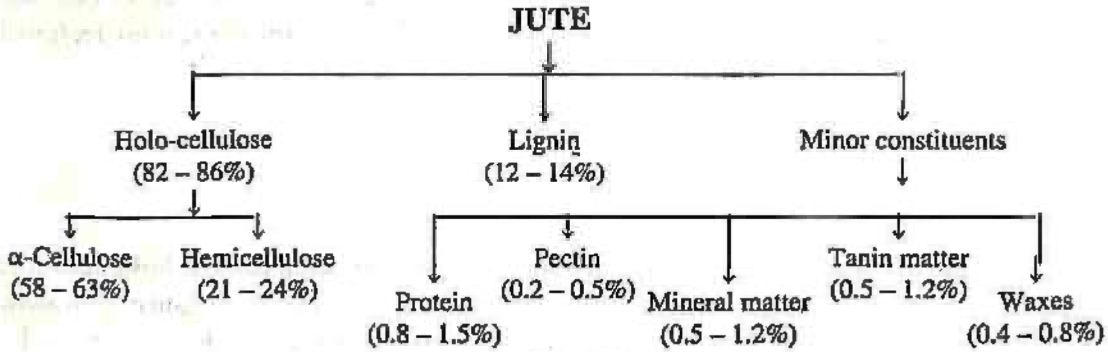
The α-cellulose component consists mainly of cellulose chains with glucose as the ultimate building units like cotton and is also associated with small amounts of other sugar residues i.e. xylan, glucouronic acid, etc. It is resistant to oxidising agents.

2.2 Hemicellulose

Hemicelluloses are composed of similar cellulose chain molecules but are much shorter in length and are built up of polysaccharides of relatively low molecular weight i.e. hexosans and pentosans of which xylose forms the major part together with uronic acid units. The hemicellulose may be characterised or differentiated from cellulose by : (i) their much shorter chain length, (ii) solubility in alkali and (iii) ease of hydrolysis by acid.

2.3 Lignin

The chemical composition of lignin has not been precisely established. But the functional groups and building units which make up the molecules have mostly been identified. It is characterised by high carbon content, which indicates that it is either highly unsaturated or aromatic in character along with the presence of hydroxyl, methoxyl and possibly carbonyl groups. Lignin has been found to contain 5 hydroxyl and 5 methoxyl groups per building unit, with a minimum molecular weight of 830. Most researchers believe that the structural units of a lignin molecule are derivatives of 4-hydroxy-3 methoxyphenyl propane. Lignin may therefore be looked upon as highly complex and amorphous in nature, possessing a relatively high carbon and methoxyl content, unhydrolysable by acid, insoluble in hot alkali, readily oxidisable, easily condensable with phenols and giving a number of colour reactions.



(Fig. I)

1.3 Physical properties of jute

Some of the more important physical properties of jute are given below for convenient reference:

SL. NO	PROPERTY	PERCENTAGE (%)
1.	Specific gravity	1.46
2.	Fineness (denier)	20
3.	Tenacity (g / denier) (g / tex)	4 29 - 52
4.	Wet strength (% of dry)	90 - 95%
5.	Elongation at rupture	1.0 - 1.4
6.	Hygroscopicity at 65% R.H.	12.0
7.	Specific heat (Cal / gm / ^{0}C)	0.324

4 CHARACTERISTICS OF JUTE AS A TEXTILE FIBRE

Jute has certain unique qualities for many important textile and handicraft applications; in that it is agro- renewable, has high strength, good hygroscopicity and a special textural appeal due to coarseness of yarns in jute fabric, can be blended with natural/man-made / protein fibres, can be woollenised, and provides excellent material for interior decoration. Because of these virtues, scarcity and high price of cotton and linen fibre, jute is extensively chemically processed in the organised and decentralised sectors for the manufacture of household textiles, life-style usage and decorative handicrafts.The conventionally bleached and/ or dyed jute goods lack in functional properties such as wear properties and colourfastness which is believed to be due to the following constraints of jute as a textile fibre:

i) Yellowing / browning of jute on exposure to sunlight.

ii) Dyed jute goods generally show poor colourfastness.

iii) Susceptibility to chemical treatments.

iv) Harsh feel, surface fuzziness & fibre shedding on abrasion.

5 PROBLEMS IN CHEMICAL PROCESSING IN JUTE

Although jute is a natural fibre like cotton, it differs in chemical composition from the latter. Unlike cotton, jute contains about 40% non-cellulosic matter (mainly hemicellulose and lignin) The action of chemical reagents on jute is therefore somewhat different from that of cotton. Consequently, the processes commonly used for preparation / bleaching / dyeing of cotton are not directly applicable to jute.

In the scouring process, for example, cotton is boiled with caustic soda solution under pressure for removal of impurities and improvement of absorbency. But jute cannot be treated in the same manner as cotton because boiling of jute with caustic soda under pressure removes a substantial portion of hemi-cellulose resulting in high loss of tensile strength and weight. Hence, despite the presence of natural golden brown colour in jute and presence of mineral oil (added to facilitate spinning of the jute fibre), it is directly bleached after a hot or cold rinse or an acid steeping or a neutral / mild scouring.

Although bleaching of jute can be effected by all common bleaching agents, bleaching powder and hydrogen peroxide find more suitable commercial applications. However the main drawback of hypochlorite or peroxide bleached jute is its photo-yellowing on exposure to light which is believed to be due to the presence of non-cellulosic component i.e. mainly lignin. This yellow-brown colour can be removed by a second bleaching treatment, however it reappears on further exposure to light.

Jute can also be dyed in a wide variety of shades with almost all classes of dyestuffs, anionic or cationic, due to the presence of both cellulosic and non-cellulosic constituents. However, many dyestuffs which give excellent colourfastness on cotton and wool do not show the same level of high fastness on jute.

Jute yarn is very hairy and thus a jute fabric has more hairiness than cotton fabric. This surface hairiness persists even after bleaching and makes printing difficult. The hairiness can be rendered less apparent by mangling or calendering but when the mangling effect is removed due to subsequent wet processing, the hair becomes pronounced again. Singeing of jute fabrics gives better results than cropping or shearing, however it is not perfect.

Jute based fabrics after bleaching and / or dyeing lack in functional properties like harsh and stiff feel, fibre shedding characteristics, poor draping quality, etc.

6 TECHNOLOGY DEVELOPED FOR ORGANISED & DECENTRALISED SECTORS

IJIRA has recently carried out considerable work on improvement of photo- stability (i.e. colourfastness to light) and other functional properties of both bleached and / or dyed jute. The chemical operations which can be suitably applied to jute to modify its fibre properties and also make the fibre more attractive and useful especially for diversified jute products are summerised below:

i) Solvent Assisted Aqueous Scouring Process

The object of emulsified solvent scouring is to remove mineral or jute batching oil (JBO) together with other adhering/ extraneous impurities since the JBO, if present in jute, has a delustering effect and also contributes additional yellowing on exposure to light. The other advantage is that strength of the material processed / scoured with the emulsified solvent system is not affected.

ii) Chemical Softening of Jute

The purpose of treatment is to impart softness and improve handle of jute based textile products. The improvement may be attributed to the break-down of the alkali sensitive chemical linkages and dissolution of a fraction of the hemi-cellulose component. The losses in weight and strength suffered by the treated materials are around 6-8% and 10-15%, respectively

iii) Chemical Dehairing and Lightfast Bleaching of Jute Fabric

Conventional peroxide or hypochlorite bleaching process primarily improves/ brightens the colour of jute fabrics only. Main short-comings of these bleached fabrics are photo-yellowing on exposure to light and surface hairiness.

In view of this, IJIRA has successfully developed Chemical Dehairing Process based on removal of lignin from the surface layer of the fabric, so that drastic strength and weight losses could be avoided. The process has been patented and consists broadly of the following steps:

Hypochlorite oxidation → Extraction → Bleaching with peroxide

The advantages of this process are as follows :

a) Fastness rating to light of about 3 on all jute fabric as against a rating of 1 on the conventionally bleached jute fabric. Higher fastness to light is obtained on jute- cotton union / blended fabrics.

b) Smooth surface and no fuzziness

c) Losses in weight and strength are within tolerable limit.

This process however has one limitation i.e. it is not applicable to yarns.

iv) High quality and High Colourfast Dyeing

Systematic studies of dyestuffs on jute have been carried out at IJIRA. In these studies, a large number of dyestuff categories including acid, basic, metal-complex, direct, reactive, sulphur, vat and pigment classes have been used to test dyeings, by the exhaust method, on 2% hydrogen peroxide bleached jute fabrics except for the pigment class which was done by pad-dry- cure method on jute. Only 60% of dyestuffs studied had the level of colourfastness grade 3 or above. These selected dyestuffs can be judiciously applied to jute to achieve the desired level of colourfastness. *The list of colourfast dyes can be obtained from IJIRA on request.*

v) Energy Saving Dyeing Processes

a. Combined scouring and dyeing of jute with acid, basic and direct dyes:

Advantages, savings in:
* Process time; * Heat energy * Water consumption

b. Single-bath bleaching and dyeing of jute with direct dye :

Advantages, savings in:
* Process time * Steam energy * Electrical energy * Water

c. Cold pad -batch method of bleaching and /or dyeing with direct dyestuffs:

Advantages:	* Higher productivity than batch dyeing.
	* Optimum use of available equipment.
	* Energy saving.
	* Savings in water consumption.

Disadvantages: All dyes are not suitable to be applied by this process.

vi) Natural Dyeing & Printing of Jute Based Fabric

Jute is a natural fibre and has natural affinity for natural dyes due to presence free carboxyl groups (-COOH). Mordants sometimes enhance the colourfastness properties. Jute has also affinity for almost all classes of synthetic dyes, anionic or cationic, due presence of both cellulosic and non-cellulosic components.

Jute fabric has therefore been dyed as well as printed with natural colourants with moderate to good colourfastness. A shade card for colourfast natural dyes on jute has been developed along with a catalogue of its colourfastness properties.

Colourfast printing technology using natural colourants and natural gum or eco-friendly synthetic thickener has also been developed for home furnishing and shopping / fancy bag applications.

vii) Odour Free Printing of Jute Fabric

Jute bags for 'Basamati rice' or shopping/ fancy bags are generally printed with pigments using kerosene or mineral turpentine oil (MTO). Consequently, it gives off bad smell and affects the aroma of the contents.

Process for odour-free printing of jute fabric using natural polymer /eco-friendly thickener and binder has been successfully developed.

viii) Finishing

The object of finishing is to confer special properties in order to meet the appropriate in- service requirements and consumer satisfaction.

Jute fabric after bleaching and / or dyeing still lacks in some functional properties like harsh and stiff feel, fibre-shedding, poor draping quality, etc. These require further improvement if jute is intended to be compared with cotton / viscose in furnishing appeal and decorative uses. The following processes are generally recommended :

a) Improvement in softness and drape :

Treatment with a very dilute solution of sodium hydroxide at an elevated / high temperature followed by aftertreatment with a cationic softener or polyethylene emulsion resets a remarkable improvement in softness, feel/ handle and drapability too.

b) Improvement in resistance to fibre-shedding and abrasion:

To improve the resistance to fibre-shedding and abrasion, some thermoplastic resins, elastomers, cellulose gum and acrylic co-polymer are recommended.

c) Stain / soil resistant finishing (*under development*)

To resist staining by coffee, tea, cold drink, fruit juice, etc. especially on carpets, soft luggage, shopping bags, etc.this finish is given.

Ackonowledgement

The author wishes to thank Prof. (Dr.) P. K. Banerjee, Director, IJIRA for permitting presentation of the paper at this conference.

SOME PRACTICAL APPROACHES TO CHEMICAL PROCESSING OF A COTTON AND COTTON/POLYESTER FABRICS

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Abstract

Ever since its discovery a few centruries ago, cotton has retained its fascination with special charm right up to the present day. Cotton occupies a prominent place amongst other textile though it has some deficiencies. These deficencies include presence of natural fats & waxes, colour etc. which makes the fibre hydrophobic and hence have to be removed so that proper chemical processing can be undertaken for value addition. Further the feel, drape, anticrease property etc. are also poor as compared to other natural & synthetic fibres. The marked swing towards natural fibres particularly cotton or at least towards its blends with other fibre has propelled high quality chemical processing in the very competitive textile field.

Every process house is not equipped with all the requisite processing machinery. Accordingly, processing sequence or flow charts are to be made so that the best possible production can be undertaken for value addition. In the present study, an overview have been made for wet processing of cotton and cotton / polyester, both woven and knitted fabrics with possible practical recipes used at different stages in the industry. The paper also aims at elaborating machinery requirement for woven and knitted fabrics and their processing sequence.

1 PROCESSING OF COTTON (WOVEN & KNITWEAR)

Chemical processing of cotton is a very lengthy process due to the presence of waxes and pectines. There have been several developments in the past years. The general processing sequence is given below:

Chart 1 : General processing sequence of Cotton Knitwear

SCOURING

(1% NaOH, 0.25% nonionic detergent, at 90^0 C for 2 hours)

↓

WASH

↓

SODIUM HYPOCHLORITE BLEACHING

(3 g/l of NaOCl for 40 mins.)

↓

WASH

↓

SODIUM HYPOCHLORITE BLEACHING

↓

(2 g/l of NaOCl for 30 mins.)

WASH

↓

ACID NEUTRALISATION

↓

WASH

↓

HYDROGEN PEROXIDE BLEACHING

(2% H_2O_2, 2% sodium metasilicate, 0.5% NaOH, at 90^0 C, for 1 hour & pH of 11)

↓

WASH

↓

FINISHING

(1% non-ionic or silicon softner & 0.3% optical brightening agent)

↓

DRY

Chart 2 : Batchwise processing sequence of Woven Cotton Fabric in open width

SCOURING

- Rapid desizing enzyme (1 to 2% o.w.f..)
- HCl (0.5% o.w.f.)
- Wetting agent: non-inoic (0.25% o.w.f.)
  anionic (0.75% o.w.f.)
- at 50^0 C for 30 to 45 mins.

↓

HOT WASH (2 changes)

↓

SCOURING

- NaOH (1 to 1.5% o.w.f.)
- Anionic wetting agent (0.5% o.w.f.)
- Jigger - at 90^0 C for 4 hrs
  J-Box - at 100^0 C for 1 hr

↓

HOT WASH FOLLOWED BY COLD WASH

(wet or dry mercerising wash & neutralisation)

↓

HYPOCHLORITE BLEACHING

(3 to3.5 g/l Av. Cl_2 at R.T for 45 mins. & pH - 11)

↓

HYPOCHLORITE BLEACHING

(3 to 3.5 g/l Av. Cl_2 at R.T. for 45 mins.)

(Total Av. Cl_2 consumption should not be more that 1.5% to 2% o.w.f, since it is in this particular process that maximum fibre damage occurs in the preparatory process.)

Chart 3 : Semi Continuous processing of Woven Cotton Fabric in rope form

SINGEING

↓

DESIZING

↓

WASH

(1% rapid desizer, for 1 hr & pH- 4 to 5 with HCl)

↓

SCOURING (Kier, pressure boil)

(Recipe same as before at 20 ibs/SQ inc. pressure & 105^0 C for 4 to 6 hrs.)

↓

MERCERISING

↓

WASH

↓

NaOCl BLEACHING

(Recipe as mentioned earlier)

↓

WASH

↓

H_2O_2 BLEACHING IN J BOX

(Recipe as mentioned earlier.)

↓

WASHING & SCUTCHING

(Open width)

↓

WASH

↓

ACID WASH

(0.25% o.w.f. H_2SO_4 / 0.5% w/w solution)

↓

WASH

←

H_2O_2 BLEACHING

50% H_2O_2 (2% o.w.f.)

sodium silicate ($Na_2O : SiO_2 \rightarrow 1:1$)

(2.5% to 3% o.w.f.) NaOH (0.25% o.w.f.)

at 90 to 95^0 C for 60 – 80 mins., & pH – 11 to 11.5

↓

FINISHING (with optical whitener)

FINISHING

(with optical brighting agent in stenter)

↓

DRY

Chart 4 : Batchwise processing of Knitted Cotton Fabric in rope form (winch machine)

(I)

(a) **MULTIPLE BATH SCOURING**
(with alkali for 2 hrs)
↓
WASH
↓
NaOCl BLEACHING
↓
NaOCl BLEACHING
↓
HOT WASH
(with 0.2% H_2O_2)
↓
ACID NEUTRALISATION
↓
WASH
↓
H_2O_2 BLEACHING
↓
FINISHING
(with 0.5% o.w.f. OBA)
↓
DRYING
(in open air or conveyer dryer or drying chamber)

(I)

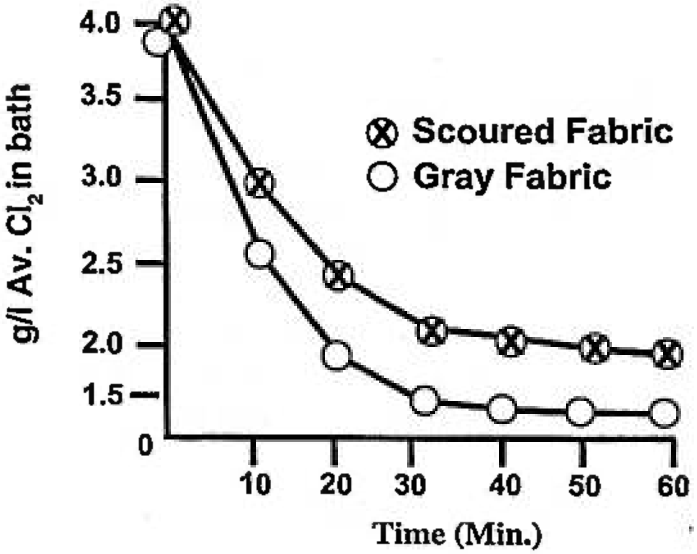
(b) **MULTIPLE BATH SCOURING**
(in winch with a detergent)
↓
NaOCl BLEACHING
(3.5 g/cc)
↓
NaOCl BLEACHING
(3.5 g/cc)
↓
WASH
↓
ACID WASH
↓
WASH
↓
H_2O_2 BLEACHING
(Same as 'a')
↓
FINISHING
(Same as 'a')

(II)

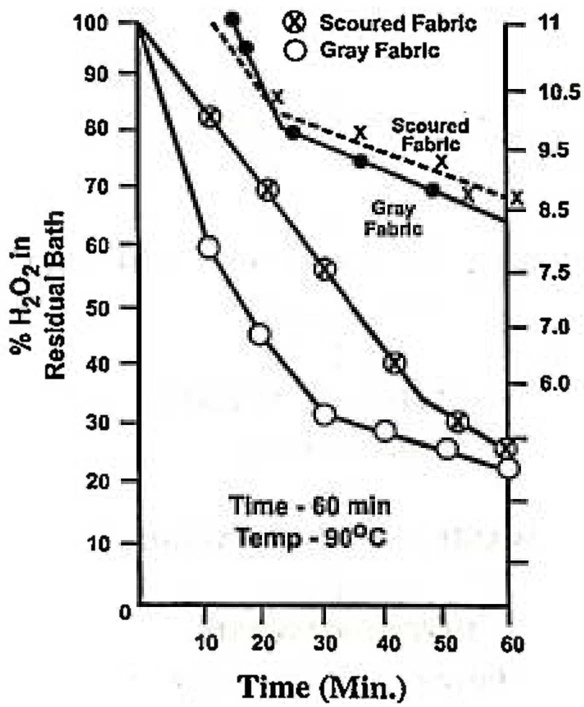
SINGLE BATH SCOURING & BLEACHING
(in winch or soft flow machine with a detergent and H_2O_2 for 3 to 4 hrs.)

Recipe :
1.5% o.w.f. NaOH
6 – 8% o.w.f. H_2O_2
8 – 10% o.w.f. sodium meta silicate
(0.5% o.w.f.) OBA
at 90° C for 3 to 4 hrs.
& pH – 11.5
↓
WASH
↓
FINISHING
↓
DRYING

Rate of Decomposition of NaOCl in Cotton Bleaching



Rate of Decomposition of H_2O_2 in Cotton Bleaching



2 DYEING

2.1 Dyeing of Cotton (Knitwear)

Selection of dyes viz. Reactive dyes is very important for dyeing cotton knitwear, since fabric is dyed in the rope form. Good levelling dye with good exhaustion properties should be used :

Chart 5 : Dyeing of Cotton Knitwear with Reactive Dyes.

SCOURING & BLEACHING

* 3% o.w.f. soda ash
* 2% o.w.f. H_2O_2
* 2% o.w.f. sodium metasilicate
* 0.5% o.w.f. non-ionic detergent
* at 80^0 to 90^0 C for 1.30 hrs.

↓

WASH

↓

NEUTRALISATION

(with acetic acid)

↓

WASH

↓

ADDITION OF DYES

(for 1 hr.)

↓

ADDITION OF SALT & SAMPLE CHECKING

(for 30 mins.)

↓

ADDITION OF ALKALI

(for 30 mins.)

↓

WASH AND NEUTRALISE

↓

HOT SOAP WASH

(to remove unfixed dyes)

Chart 6 : Batchwise finishing and dyeing of Woven cotton fabric in a Jigger/ Batchwise dyeing of Knitted cotton fabric in a soft flow machine.

WETTING
(0.4% o.w.f. non-ionic detergent)
↓
SCOURING & BLEACHING
* 1.5 to 2% o.w.f. H_2O_2
* 2 to 3% o.w.f. soda ash
* 2 to 3% o.w.f. sodium metasilicate
* 0.5% o.w.f. NaOH
* at 70 to 90^0 C for 2 hrs & pH – 11 to 11.5

↓
2 WASHES
↓
ACID WASH
(1% o.w.f. acetic acid)
↓
ONE WASH
↓
DYEING
Dye addition :
- for light shades – 45 mins
- for medium shades – 30 mins
- for deep shades – 20 mins

↓
SALT (as recommended for 30 minutes)
SODA (as recommended for 1 hour)
(Check matching)
↓
2 COLD WASH
↓
NEUTRALISATION
(with HCl)
↓
COLD WASH
↓
TWO HOT SOAPING
↓
COLD WASH
↓
FINISHING
(with cationic softner)
↓
DRYING

Chart 7 : Batchwise finishing and dyeing of Knitted Cotton Fabrics in rope form (winch/soft flow machine.)

SCOURING AND BLEACHING

* 2% o.w.f. H_2O_2
* 3% o.w.f. sodium metasilicate)
* 2% o.w.f. soda ash)
* 0.25% o.w.f. non ionic detergent
* at 80 to 95^0 C for 2 hrs.

↓

WASH

↓

NEUTRALISATION

↓

DYEING

↓

FINISHING

(with cationic softner and or amino silicone softner)

2.1 Dyeing of Woven Cotton Fabric

The various dyeing methods practised in the textile industry are as follows:

a) Batch process of dyeing technique

i) Direct colours for low cost fabric using Pad-Batch.

X% dyestuff
100 g/l urea
1 cc/l non ionic detergent
1 g/l anti-migrating agent

Batch for 12 to 16 hrs under constant rotation → wash off (two rinses in cold water) → dye-fixing → dry

ii) Reactive colour for value-added fabric (approximately 80% of the dyed production in the textile industries are done using this class of dye with exception is some cases where vat, azoic & sulphur dye are used).

b) Semi-continuous method of dyeing

Pad-batch process for woven and knitted fabrics is very seldomly used for semi-continuous or continuous dyeing due to the high cost of capital investment involved for the development of a particular shade on long lengths (5000 mts. onwards.) of fabric.

Chart 8 : Semi Continuous dyeing of Cotton Knitted & Woven fabrics.

BLEACHED AND OR MERCERISED FABRIC

↓

SEPARATE DYE & ALKALI MIXER

(X% dyestuff, 100 – 150 gm/l urea, 75 to 80 g/l (78° Tw) sodium silicate, 2 cc/l non-ionic detergent, 2 to 3 gm/l NaOH for avoiding migration)

↓

PAD THE FABRIC

(in 3 bowl padding mangle)

↓

DWEEL

(for 16 to20 hrs. in a rotating roller at room temperature)

↓

WASHING & SOAPING

(soaper or jigger machine)

↓

FINISHING

↓

DRYING

Chart 9 : Two stage dyeing of Polyester/Cotton blended Woven fabric.

DESIZING & SCOURING

(1% rapid desizer, 2% NaOH, 0.5% detergent for 4 hrs.)

↓

WASH

↓

DRY

↓

MERCERISING

↓

DRYING

↓

HEAT SETTING

(at 180^0 C for 30 to 40 mins.)

↓

DYEING OF POLYESTER IN A BLEND

(in soft flow)

↓

DYEING OF COTTON IN A BLEND

(in Jigger)

↓

FINISHING

Chart 10 : Two stage dyeing of PET/Cotton blended Knitwear Fabrics.

SCOURING & BLEACHING

(in soft flow dyeing machine)

(3% soda ash, 0.5% detergent, 0.2% defoamer, 2% hydrogen peroxide, 2% sodium meta silicate, at 90 to 100^0 C for 90 mins & pH - 11)

↓

WASHING

↓

DYEING OF POLYESTER IN A BLEND

↓

SOAP WASH

↓

NEUTRALIZATION WITH ACETIC ACID

↓

DYEING OF COTTON IN A BLEND

↓

SOAPING & WASHING

↓

FINISHING

TABLE 1 : LATEST YARN CONVERSION TABLE

Use this formulas to convert one yarn numbering system to another

	Cotton count	Denier	Worsted count	Wool count	Linen lea	Wollen count	Wollen run	Jute count	Metric count	Grain/ 120y	Tex count
Cotton count	—	5,315 / CC	CCx 150	CCx52.5	CCx 2.80	CCx2.80	CCx0.525	17.14 / CC	CCx1,693	1,000 / CC	590.5 / CC
Denier	5,315 / D	—	7,792 / D	279,030 / D	14,880 / D	14,880 / D	2,800 / D	Dx0.003225	9,000 / D	Dx0.1881	Dx0.1111
Worsted count	WC / 1.50	7,972 / WC	—	WCx35.0	WCx1.867	WCx1.867	WCx0.350	25.71 / WC	WCx1.129	1,500 / WC	885.8 / WC
Wool count	W / 52.50	279.030 / W	W / 35.0	—	W / 18.75	W / 18.75	W / 100	900 / W	W / 31.00	52,500 / W	30,975 / W
Linen lea	LL / 2.80	14,880 / LL	LL / 1.867	LLx18.75	—	LL	LL / 5.33	48.00 / LL	LLx0.605	2,800 / LL	1,654 / LL
Woollen cut	W/C / 2.80	14,880 / W/C	W/C / 1.867	W/Cx18.75	W/C	—	W/C / 5.33	48.00 / W/C	W/Cx0.605	2,800 / W/C	1,654 / W/C
Woollen run	W/R / 0.525	2,800 / WR	WR / 0.350	WRx1.00	WRx5.33	WRx5.33	—	9.00 / WR	WR / 0.31	525.0 / WR	310.0 / WR
Jute count	17.14 / JC	JCx3.0	25.71 / JC	900 / JC	48.0 / JC	48.0 / JC	9.00 / JC	—	29.03 / JC	JCx58.33	JCx34.45
Metric count	MCx0.5905	9,000 / MC	MC / 1.129	MCx31.00	MC / 0.605	MC / 0.605	MCx0.310	29.03 / MC	—	1,693 / MC	1,000 / MC
Grains/120y	1,000 / GR/120y	GR/120y / 0.1881	1,500 / GR/120y	52/500 / GR/120y	2,800 / GR/120y	2,800 / GR/120y	525.00 / GR/120y	GR/120y / 58.33	1,693 / GR/120y	—	GR/120y / 0.5905
Tex count	590.5 / TC	TC / 0.1111	885.8 / TC	31,000 / TC	1,654 / TC	1,654 / TC	310.0 / TC	TC / 34.45	1,000 / Tc	TC / 0.5905	—

EFFECT OF TREATMENT WITH SOME SURFACTANTS ON REACTIVE DYED COTTON FABRIC.

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Abstract

Four different types of selective surfactants were used in single washing treatment of reactive dyed cotton fabric, to assess the change of surface colour strength, after washing of the dyed fabric. Washfastness rating by using grey scale and washing performance in terms of retention of the colour-depth of the reactive dye dyed cotton fabric was assesed and compared by measuring the corresponding K/S and colour difference (ΔE) values after washing with these surfactants by ISO-II and ISO-III method of washing. Among the four surfactants under investigation, surfactant B is found to show an overall balanced performance in terms of the retention of the depth of colour after washing as compared to the other surfactants studied.

1 INTRODUCTION

Depending on the type of charge present in the long chain portion of the surfactant molecule in wash liquor (usually water) after dissociation, the surfactants are classified into the following four groups:-

i) Anionic Surfactant , e.g. Alkyl benzene sulphonate and Sodium lauryl sulphate.

ii) Nonionic Surfactant, e.g. Lanolin ethoxylate and Glycerol mono stearate.

iii) Cationic Surfactant,e.g. Dodecyl dimethyl ammonium chloride and Distearyl dimethyl ammonium chloride.

iv) Amphoterics, e.g. Lauryl dimethyl betaine and Coco–amido propyl betaine.

A specific class of detergent surfactant has its specific effectiveness, however its main function as detergent is its capability to remove soil / adhered particles from the textile surface and prevent its redeposition. However, during washing of dyed fabrics, the effect of different surfactants varies depending on their chemical nature.

Cotton[1-3] fibre attracts dirt / dust / soil by both dry and wet soiling mechanism, as it has good absorptivity and is prone to easy moisture absorption. Cotton can be dyed by many class of dyes; reactive dyes usually give maximum rating of wash fastness on cotton.

There is limited availability of scientific literature on the effect of different classes of surfactant on dyed cotton fabric. Hence, the authors felt the need for carrying out the present study and assessing the effect of treatment with different types of surfactants on dyed cotton fabric. Selective surfactant from each of anionic, cationic and non-ionic nature were selected to study their effectiveness during washing of reactive dyed cotton fabric using varying concentration of detergents, in terms of the retention of colour depth after washing.

2 MATERIALS AND METHODS

2.1 Materials

2.1.1 Fabric

100% bleached (white) plain woven cotton fabric was used, having the fabric specifications as: warp thread density of 116 ends / dm, weft thread density of 82 picks / dm, area density of 95.0g/m2, warp yarn count of 32.2 tex, weft yarn count of 29.0 tex, and fabric thickness of 0.30mm.

2.1.2 Chemicals & Dyes

Hot brand reactive dye, 'Procion Brilliant Orange H2R' (CI Reactive orange13) obtained from ATIC Industries, Valsad, Gujarat was used for the present study. For dyeing, commercial grade of sodium chloride, sodium carbonate, were used. Surfactants of different class taken were as follows:

Surfactants	Manufacturer
i) Alkyl benzene sulphonate	Gandhi Parekh Corpn. Pvt. Ltd, Mumbai.
ii) Sodium lauryl sulphate	Diamond Chemical Corpn., Mumbai.
iii) Glycerol mono stearate	Ashvind Chemical, Mumbai.
iv) Distearyl dimethyl ammonium chloride	Laffans Petrochemical Ltd, Mumbai.

2.2 Methods

2.2.1 Washing

One cycle of washing of the dyed cotton fabric samples were carried out in a launderometer following ISO-II washing method using different concentrations such as 0.5%, 1%, 1.5%, 2%, and 5% of aqueous solution of the surfactants.

2.2.2 Dyeing with reactive dye

The dyeing of the cotton fabric sample was carried out using a selective reactive dye (1% o.w.f.) with the material to liquor ratio of 1 : 30 and using 20g/l soda ash and 75g/l common salt as auxiliaries which were added in the dye bath as per the usual sequence and timings used in standard reactive dyeing procedure[4]. The dyebath was initially set at 50°C along with the dye and the textile substrate was introduced into the dyebath. After 10 min of dyeing at a temperature of 50°C, half of the required salt was added. After 20 min of dyeing at 60°C, the remaining 50% of the salt was added to the dyebath. The dyebath temperature was then raised to 85°C in another 30 min. After 50 min of dyeing, half of the alkali (Na_2CO_3) was added to the dyebath at 85°C. After another 15min, remaining alkali was added and dyeing was continued for another 60 min. After the dyeing was over, the dyed fabric was washed with hotwater, soaped, washed with cold water again, finally rinsed and dried in air.

2.2.3 Determination of wash fastness

Wash fastness rating of cotton fabric samples dyed with reactive dyes was assessed as per the IS: 3361- 1979 and IS: 764- 1979 [5], after washing the samples, following equivalent to ISO-II as well as ISO-III washing conditions (for ISO-II, surfactant: 5g/l, temperature: 50_+ 2°C, material to liquor ratio of 1:50, time: 45 min. and for ISO- III, surfactant: 5g/l, soda ash: 2g/l, temperature: 60_+ 2°C, material to liquor ratio of 1:50, time: 30 min).

The fabric samples to be tested were cut to a size of 10 cm X 4 cm and the test specimens sandwiched between two pieces of cloth (bleached cotton fabric on one side and bleached wool fabric on other side) and then the four sides were stitched. These samples were subjected to washing in a SASMIRA-launderometer using all the four different surfactant solutions of appropriate concentration as per ISO-II and ISO-III methods.The change in colour of the washed fabric and staining on adjacent cotton and wool fabric was assesed / rated using the corresponding grey scales, verified by Macbeth 2020 plus reflectance spetrophotometer and associated colourlab plus software.

2.2.4 Measurement of surface colour strength

Surface colour strength [6,7] (K/S value, indicating dye shade depth on the fabric surface) was determined by measuring the corresponding reflectance values using Macbeth 2020 plus reflectance spectrophotometer and calculating the K/S value using the following Kubelka - Munk equation:

$$K/S = \frac{(1 - R\lambda max)^2}{2\ R\lambda max} = \alpha c$$

where, c is the concentration of the dye, α is a constant and $R\lambda_{max}$ is the reflectance of the fabric sample at a particular wave length where maximum absorption occurs.

Also, colour difference (ΔE) was measured by measuring L*, a*, b* values using colourlab plus software and Macbeth 2020 plus reflectance spectrophotometer, with the following CIE-Lab equation:

$$\Delta E = [(\Delta L^*)^2 + (\Delta a^*)^2 + \Delta b^*)^2]^{1/2}$$

$$\text{Where } L^* = 116\,(y/y_n)^{1/3} - 16$$

$$a^* = 500[(x/x_n)^{1/3} - (y - y_n)^{1/3}]$$

$$b^* = 200[(y/y_n)^{1/3} - (z - z_n)^{1/3}]$$

Where x_n, y_n, z_n are the three tristimulus value of a standard white surface of MgO (or equivalent surface of standard white tile) and x, y and z are three tristimulus values of the corresponding sample.

3 RESULTS AND DISCUSSION

Four different types of selective surfactants (A- Alkyl benzene sulphonate, B - Sodium lauryl sulphate, C- Glycerol monostearate and D- Distearyl dimethyl ammonium chloride) with fixed or varied concentration level were used for single wash of reactive dyed cotton fabrics to asses the changes of surface colour strength.

3.1 Effect of single wash on wash fastness of reactive dyed cotton fabric.

The wash fastness rating of reactive dyed cotton fabric using these four selective surfactants at 5% (5g/l) concentration level was studied on washing the dyed samples by both ISO – II and ISO – III standard methods of washing. The corresponding changes on loss of depth of colour was assessed by both grey scale rating as well as by instrumental measurement of colour strength, and colour differences determining K/S values and ΔE values using reflectance spectrophotometer with computerised colour measurement software. The results are shown in table 1. It can be observed, from the data of wash fastness rating that the lowest loss of depth (maximum retention of colour and minimum ΔE. However surfactant-B is also shows reasonably good results in terms of washfastness rating being next better to surfactant-A, vide table 1. Colour fading behaviour of dyed cotton fabrics including those dyed with reactive dyes on multiple washing is being studied extensively [6] using a standard surfactant; however the effect of different type of surfactants on colour fading has not been reported earlier. For all these surfactants, the loss of depth of colour has been to some extent, expectedly, higher in ISO-III method of washing, as compared to that of ISO-II method of washing though the differences is not much significant for the obvious reason of higer washfastness expected for reactive dyes due to their covalent nature of bonding with the cellulosic fibres.

3.2 Effect of single wash on loss of depth of colour in terms of change in K/S value.

Another interesting study was made to understand the effect of varying concertrations of the surfactant on the wash fastness ratings, deviating from the recommended soap / detergent concentration for ISO II method, but keeping other conditions of the washing strictly as per ISO-II washing conditions. The relative surface depth of colour in terms of K/S values (surface colour strength) after single wash of reactive dyed cotton fabric with 0.5 to 5% solution of the selective surfactants have been graphically shown in fig-1. It can be observed from curves A, B, C and D (fig-1) that for surfactant-A, the surface colour strength value is reduced (amounting to a small extent) at higher rates than other surfactants with the increase in surfactant concentration from 0.5% to 1.9% (2% level), after which there is almost no further loss in surface depth of colour. On the contrary, in case of the use of 5% level of surfactant concentration for washing of reactive dyed cotton fabric, a slight upward trend in K/S values is observed for almost all the surfactants. For all other surfactants B, C and D, with the increase in surfactant concentration from 0.5 to 1.5%, the reduction in the colour strength values on ISO-II single wash of the reactive dyed cotton fabric is always smaller than that of surfactant-A. Among B, C and D, the relative rate of surface colour strength reduction for ISO-II wash is in the following order;

$$A > D > C > B.$$

For surfactant-B, the reduction of surface colour strength by ISO-II wash continues almost upto 1% surfactant concentration after which there is no further loss in depth of colour though at 1% - 5% level there is a very small increasing trend of surface colour strength value.

For surfactant-C, the small reduction in surface colour strength also continues upto 1% level of surfactant concentration and then it shows an upward trend at 2% level of concentration after which there is almost no further loss in surface depth of colour. At 5% concentration level, surfactant-C, shows a minor upward trend in the observed K/S value. For surfactant-D, the surface colour strength follows the similar trend to that of surfactant-C, but shows a little higher loss in surface depth of colour at all level of surfactant concentration.

However, the interesting observation of the little upward trend of K/S values at higher (5% level) level of concentration for all the four surfactants particularly either after different threshold limit of corresponding CMC level of concentration for different surfactant or at 5% level of concentration of those surfactants, can be explained by the known phenomena that the increased orientation of the dye molecules occurs predominantly on washing with higher concentration level of surfactants thereby increasing the reflectance or lusture of the coloured surface showing a minor / small increased K/S value, as observed (fig-1).

4 CONCLUSIONS

4.1 The wash fastness rating of reactive dyed cotton fabric in terms of higher retention of surface depth of colour after washing (both by ISO – II and ISO – III using 5 g/l surfactant solution) is found to be relatively better in case of surfactant B, while surfactant-D and A show next lower level of performance in this case, among the four surfactants studied.

4.2 Despite the loss of depth of colour from reactive dyed cotton fabric on washing, there is an upward trend of increase in the K/S value, to a minor extent at 5g/l concentration in case of all the surfactants studied, which may be due to an expected consequence of higher orientation of the dye molecules on washing as a result of higher level of surfactant concentration.

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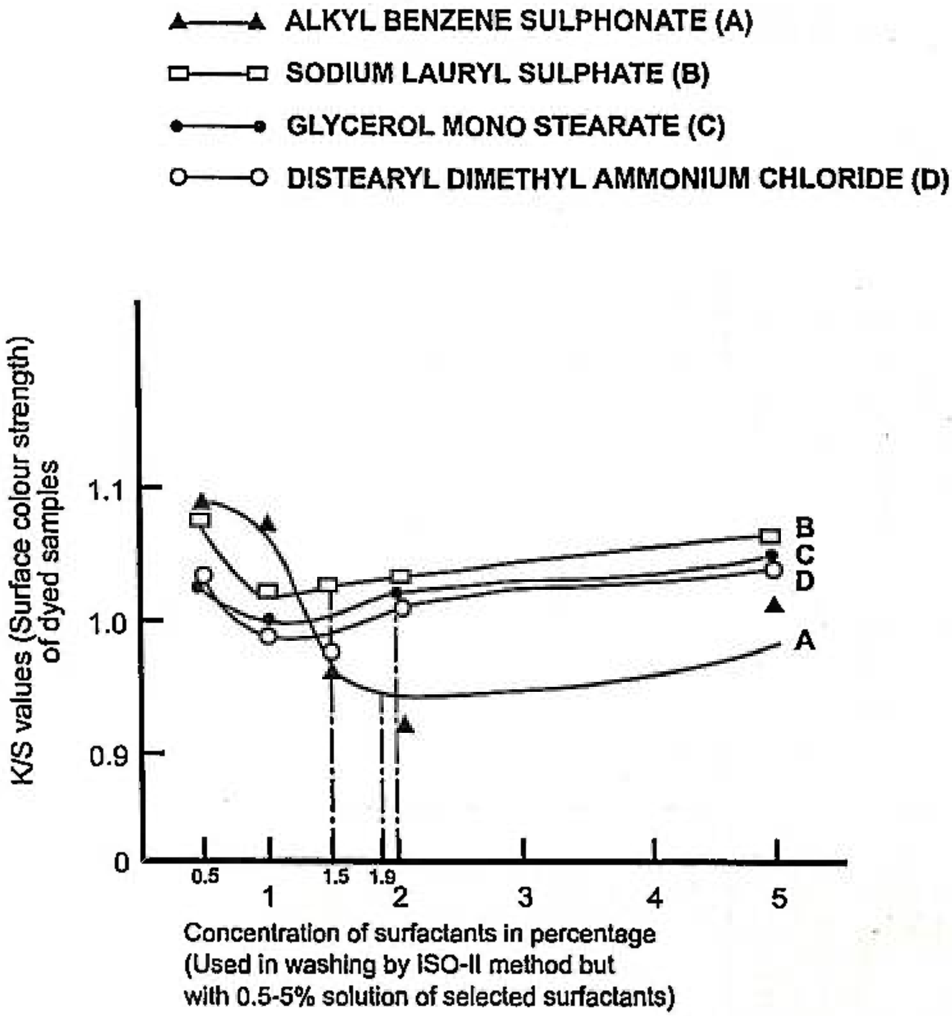

Fig - 1 EFFECT OF SINGLE WASH USING VARIED CONCENTRATION OF DIFFERENT SURFACTANT ON LOSS OF DEPTH OF COLOUR IN TERMS OF K/S VALUES (SURFACE COLOUR STRENGTH OF REACTIVE DYED COTTON FABRIC.

Table 1 : Wash fastness results by grey-scale and instrumental assessment for change in surface depth of colour of the reactive dyed cotton sample using 5g/l selective surfactants:

Surfactant	Wash Fastnes Rating							
	Method : ISO-II				Method : ISO-III			
	Loss of depth of colour		Staining on cotton		Loss of depth of colour		Staining on cotton	
	Grey scale	K/S value	ΔE	Grey scale	Grey scale	K/S value	ΔE	Grey scale
NIL (Control)	—	1.2 (100)	—	—	—	1.2 (100)	—	—
Anionic Alkyl benzene sulphate (A)	3-4	1.02 (85.0)*	1.42	3	3-4	1.03 (85.8)*	1.45	3
Anionic Sodium lauryl sulphate (B)	4	1.06 (88.4)	1.09	4	4	0.98 (81.7)	1.20	3-4
Nonionic Glycerol mono stearate (C)	3-4	1.01 (84.7)	1.20	3-4	3	1.03 (85.8)	1.35	3
Cationic Distearyl dimethyl ammonium chloride (D)	3-4	1.03 (85.9)	1.32	3	3	1.04 (86.7)	1.85	3

* Figures in the parentheses represent the relative change in colour strength in parts as compared to that of the standard control sample, whose initial colour strength is considered to be as 100 parts.

CHALLENGES IN WET PROCESSING OF MICRODENIER POLYESTER FABRIC

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Abstract

In the present paper, the general advantages and disadvantages of microdenier polyester fabrics along with its problems and challenges associated with its wet processing,(including dyeing), have been breifly dealt with. Due to the delicate nature, low torsional and flexural rigidity, higher exposed surface area, higher rate of initial dye strike, etc.,microdenier polyester fabrics pose certain difficulties in its wet processing, particularly in dyeing. The potential problems in the wet processing of microfilament polyester fabrics have been highlighted along with a mention of some reported studies on measures needed in case of its preparatory chemical processing, dyeing methods and selection of dyeing machinery as well as selection of suitable disperse dyes, dye auxiliaries and post-treatment techniques, etc.Results of some recent studies carried out by the author and associated co-workers, to meet these challenges have also been reported, particularly on chemical pre- treatments including weight reduction treatment, solvent pre-treatment, and on dyeing including dye selection and post-dyed finishing operations with some uv-absorbers and amino silicones that are suitable for wet processing of polyester microfilament fabrics..

1 INTRODUCTION

It had been a dream for the synthetic fibre technologists to obtain very fine fibres with exceptional soft feel, comfort and rich appearance,which has turned into a reality with the advent of the microfibres(1,2). The microfibres are usually of one decitex (0.9 denier) per filament (dpf) and below (0.9 dpf to about 0.5 dpf). The terms, "microfibre","microdenier fibre" and "microfilaments" are usually used interchangeably. During the 90's, the advent of polyester microfibres(1-2) was a major commercial break-through in the world of synthetic textiles. The well known advantages(3-4) of the polyester (PET) microfibre fabrics like excellent softness and high drape, silky handle with good breathability and super comfort, etc., have increased consumers' attraction towards it. The microfibre may contain three to four times as many filaments as the normal denier (> 0.9 dpf) polyester filaments, as the microdenier fibres have finer diameter, less weight per unit area (i.e. less denier) and considerably more surface area resulting in greater bulk in the yarn compared to the normal denier polyester filament yarn of comparable total denier.Hence,fabrics made from microdenier polyester filaments have gained great importance in the present market.

The polyester microfibre is becoming popular due to its several advantages mentioned above. The initial estimate of polyester microfibre production in 1992 was reported to be in the range of 80,000 tonnes worldwide, less than 1% of the projected production of a total of 8.5million tonnes of polyester fibres intended for textile purposes. In 1993, the microfibre's share in the polyester market had increased overwhelmly and it was approximately 10 to 11% in Japan, 6 to 7% in Europe and 2 to 4% in the U.S. This is rapidly growing in the fashion apparel sector as well as the technical textiles sector. Polyester microfilaments upto 0.5 dpf are now being produced in India also.

The rapid development and growth of PET microfibre in the textile field has however taken place without sufficient scientific study on its mechanical and chemical processing techniques which require varying process parameters and recipies with respect to its commercial processing in comparison to the processing of normal denier polyester fabrics. Hence, the textile chemical process houses are processing these soft microfilament fabrics with necessary changes in the process / recipe / machinery and other conditions as per the present information available to them. However, there are still many unsolved problems in the wet processing of polyester microfilament textiles.

The expected growth rate in the polyester microfibre market by the end of the century was highly promising; however it was dependent upon the rate of its success in penetrating the large fashion apparel sector with possibilities of its blends with cellulosic fibres. Most of the polyester microfibre production is still in the filament form (flat or textured). Blends in the filament form with viscose (woven goods) and cotton (knits) are becoming increasingly popular in Europe and the Asia-Pacific region. The blending of staple polyester microfibre with cotton is however, facing different problems in its mechanical processing even today , during yarn manufacture/ production.

Considering the above mentioned, rapidly increasing, versatile uses of polyester microfilament fabrics, the study on different aspects of wet processing of polyester microfibre fabric [5-11] including problems in colouration of polyester microfilament textiles is worthwhile.

In the present paper, a brief overview of the problems and challenges associated with wet processing of polyester microfibre fabrics have been dealt with along with a reference to the available scientific studies and some work done by the author.

2 SPECIFIC PROBLEMS ASSOCIATED AND MEASURES NEEDED IN THE WET PROCESSING OF MICRODENIER POLYESTER FABRIC.

2.1 Problems associated with the wet processing of microdenier polyester fabrics

The following chart is self explanatary and gives an insight to the problems associated with and the care or measures needed during wet processing of microdenier polyester fabrics.

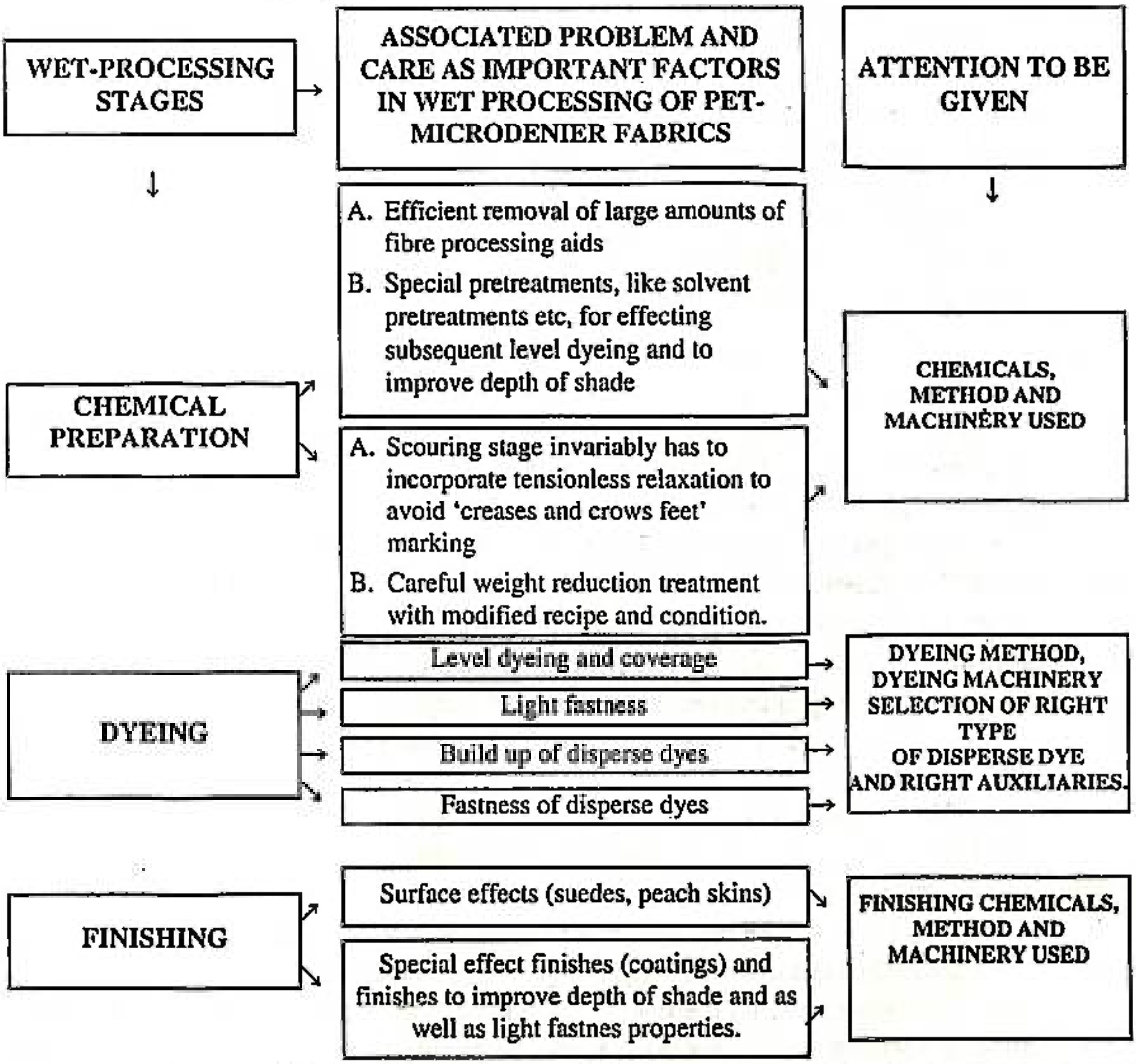

Chart highlighting the problems associated and care needed during the processing of polyester microfibre fabrics.

2.2 Measures needed in preparatory chemical processing of microdenier polyester fabrics

Owing to larger surface area, 2 to 5 times more fibre processing aids i.e. (sizes, oils, antistatics, spin finish,etc) are applied during sizing of microfilament yarns in order to help and protect the delicate polyester microfibre fabrics during processing. Therefore, care should be taken for efficient and optimal removal of the sizes and other fibre processing aids or additional soils,waxes, etc. Care is also required to minimize creasing and abrasion marks in the microfilament fabrics during chemical pre-treatments.

To minimize creasing, it is important to contol shrinkage of the microfibre fabric i.e. relaxation should occur under minimum tension (relaxation of microfibre fabric commences even at low wet-processing temperature). Also to reduce creasing, use of a suitable lubricating agent is recommended. Hence desizing and scouring of microfibre fabrics must be carried out either in a tensionless openwidth washing machine or perforated drum or in a suitable jet dyeing machine at 80^0 to 90^0C. In order to remove the large amount of sizes and other processing aids, an alkaline treatment incorporated with oxidizing agent is more feasable.

Earlier work[6,12] reported by MANTRA, (Surat), has indicated that even caustic soda treatment at 90^0 C for 30 to 45 mins. can remove higher amount of sizing and fibre-processing aids. Scouring may be carried out effectively after circulating the material with 0.25% deaerator for five mins., at 50^0C, using 2 to 4% detergent and 1% chelating agent along with soda ash at 90^0C for 30 mins., followed by cooling (upto 70^0C), rinsing, neutralisation and washing. Usually the weight reduction treatment is not recommended for polyester microfibre fabric, unless essential for other purposes. However, sometimes, it is done to produce more softness (to reduce intrinsic stiffness of the fibre), drape and delicate feel in the fabric and microfilament fabric always show a higher weight loss than that possible in case of the normal denier polyester fabric under comparable conditions of alkali treatment. Hence, considering the low weight / specific surface area of microfibre fabrics, lower weight loss (2 to 5% weight loss) is more favourable.It has been observed in our earlier study [13] that to control only 10 to 15% weight loss in microdenier polyester fabric, the optimal condition is to use 5% NaOH solution with 0.1% hexamethylene diamine (HMDA) instead of conventional cetyl-trimethyl-ammonium bromide (CTAB) as a catalyst or an accelarator at 90^0C for 60min. On treatment with 1% caustic soda solution with 1g/l HMDA as mild accelerator at 90^0C for 60min., the weight loss found is around 4.5% during the weight reduction treatment of PET microfibre fabrics. After weight reduction treatment, polyester microfibre fabrics should be soaped well at 80 to 95^0C to aid efficient removal of decomposition products (oliogomer and decomposed products of the fibre processing aids) adhering to its surface. Preheat setting of PET microfilament fabrics before dyeing should be carried out at 180^0C for 30 seconds only. However, if the fabric contains only microfilament yarns, dyeing may proceed without pre-heat setting.

2.3 Associated problems and corrective measures needed in dyeing of microdenier polyester fabrics

2.3.1 Problems associated with polyester microfibre fabrics during dyeing

The major problems[3,5,9-12,14] faced in dyeing of polyester microdenier fabrics are as follows :

i) More dye requirement for microdenier filaments for obtaining the same depth of shade as that on normal denier filaments or in other words, lighter appearence of the microfibre polyester fabrics is observed as compared to the normal denier polyester fabrics using the same amount of dye, thereby causing difficulties in matching of shades on the PET microfilament fabrics as compared to that obtained on the normal denier PET fabrics. As the filament denier becomes finer, the amount of dye required to match a particular shade depth, is increased.

ii) Difficulties in achieving level dyeing in the case of microdenier polyester fabrics due to higher rate of initial dye strike and adsorption since greater surface area couples with a more amorphous fibre structure in the microfibres, an effect which is particularly more pronounced when the starting temperature of the dyeing cycle is 60 to 70^{0}C.

iii) Difficulties in washing to remove the unfixed dyes and chemicals completely after dyeing is over, since large number of small interstices are present on the large surface area of the microfibers.

iv) The microfiber fabrics exhibit a greater rate and extent of shrinkage on raising the temperature of the dye bath.

v) Lower dye fastness to wet treatments, heat applications and on exposure to light, due to the exposure of higher surface area to the external agency.

vi) Textured / multilobal / delustured polyester microfilaments are susceptable to more dyeing variations.

vii) Inadequate care and precautions in the preparation stage may result in abrasion and crease marks in microfilament fabrics.

2.3.2 Measures needed in dyeing of polyester microfibre fabrics

Improvement in overall solidity of shade on microfilament fabrics can be achieved by careful selection of the correct type of dyeing machinery, dyeing conditions & methods, dyebath auxiliary and proper dye selection. Looking into the problems of dyeing polyester microfilament fabrics discussed above (in sub section 2.3.1), the corrective measures required for level dyeing of PET microfilament fabrics may, therefore, be discussed under the following subheads:

i) Care needed for the selection of dyeing machinery

ii) Care needed for the recommended dyeing method

iii) Care needed for the selection of dyebath auxiliaries

iv) Care needed for the selection of disperse dyes.

2.3.2.1 Care needed in the selection of dyeing machinery

Neither package nor beam dyeing machine is recommended for dyeing of polyester microfibre fabrics because of the product's high ends and picks density, which severely impairs the flow of the dye liquor through the fabric necessary for level dyeing. Continuous dyeing of polyester microfibre is not recommended. The condition is such that the advantages of the microfibres are severely obscured when handled in this manner. A variety of jet dyeing machines including the soft flow type and low liquor ratio type over flow units (overflow units helps in developing the required bulk) are more or less suitable for dyeing polyester microfibre fabrics [11,12,14]. In jet dyeing, uneven dyeing often occurs in the heating stage due to temperature differences between the interior and exterior of the fabric rope. Due to the higher surface area of microfibre fabrics, there is a consequent initial higher dye strike and absorption rate; hence the chances of uneven dyeing is more pronounced in the dyeing of microfibre fabric using conventional jet dyeing machine and dyeing method. This problem can partially be overcome by using high speed circulation (atleast 250 m/min) of dye liquor and the turnover of running fabric by suitable modification or newer design [10,11,15] of the machinery.

Microfibre fabrics are structured with a large number of small interstices with larger surface area exposed, which makes it extremely difficult to wash out any unfixed dye and chemicals completely. Therefore, the dyeing machine used should also have an efficient washing system [6,10].

GN4/5 jet dyeing machine[11,14-16] has been specifically made to handle a wide range of fabrics including PET microfibre fabrics.This machine helps to maintain the quality associated with level dyeing of polyester microfibre fabrics. In this machine, new air jet attachment has been introduced to provide a solution to reduce the variation in dyeing. This newer jet dyeing machine with air jet attachment [11,15] is especially good for dyeing pure synthetic fibres including PET microfibre fabrics at a low material to liquor ratio of 1:3.

2.3.2.2 Care needed for recommended dyeing methods

In order to obtain reproducible shades and level dyeing in polyester microfilament fabrics, conditions such as rate of temperature rise, cloth turnover time and material to liquor ratio should remain consistent from one lot to another.

A slow rate of rise in the dyeing temperature is very important in dyeing PET microfilament fabric in order to ensure on-tone dye exhaustion and migration. The recommended method of dyeing should start at a lower temperature compared to the dyeing of normal denier (>0.9 or1dpf) PET fabric and should preferably be at 40 to 45°C and which should proceed upto 90 to 95°C, with a temperature rise of 1 to 1.5°C/min.(a slower rate of temperature rise is essential as the disperse dye exhaust onto the microfibre at faster rate than on normal denier fabric). A hold period of 20 minutes at 96 to 98°C is recommended [10,14] to enhance levelness in dyeing since the rate of exhaustion of disperse dyes increase in this temperature zone. After holding for some period at 96 to 98°C, the rise of temperature upto130°C should also be at a slower rate preferably at 0.5 to 1°C/min as shown in the dyeing cycle-B in fig.1.The dyeing should then be continued at 130°C for 30 to 60 minutes depending on the dye type and depth of shade required. In our earlier publication [14] it has already been reported that for the industrial process of dyeing of PET microfibre fabrics, a much simpler and effective dyeing cycle (to avoid the above reported complicated specific dyeing programme) can be followed. Commencement of dyeing at 50 to 60°C and raising the temperature upto 100°C at the rate of 2°C/min. and holding the temperature for 20 minutes at 100°C and then raising the temperature further to 130°C at the rate of 1.5 °C/min to complete dyeing for the required time (30 to 60 min at 130°C) is shown by dyeing cycle-C in fig1, as compared to dyeing cycle-A in fig-1, which is used for dyeing of normal denier polyester fabric. Dyeing cycle-B is specifically recommended [10] for dyeing polyester microfibre fabrics with more precission control requiring more time for dyeing, which gives better dyeing results.

After the dyeing of PET microfibre fabric is over, the dye bath should also be cooled to 70°C, at a slower rate (usually1°C to 2°C/min) as shown in dyeing cycle-B or C in fig-1. At the end of dyeing, reduction clearing is to be done using 4g/l soda ash and 4g/l sodium hydrosulphite (higher amount of chemical and higher temperature is required for efficient removal of unfixed dyes from the microfibre fabrics, in comparison to that required for normal denier polyester fabrics) at 70° to 80°C for 15 min., instead of much milder reduction clearing conditions of 60°C to 70°C followed in case of the normal denier polyester fabrics.

2.3.2.3 Care needed in selection of dye bath auxuliaries:

Care in selection of proper dyebath auxiliaries needs to be stressed upon considering the following points[10] :

i) A very powerful high temperature stable anionic dispersing agent should be used which can disperse both the dye and oligomers (adhered to the larger number of interstices of PET microfibres).

ii) An auxiliary should be added into the dye bath which can emulsify residual anionic oils, waxes and other contaminants including the residue of chemicals applied as fibre processing aids which remains usually adhered to the microfibre fabrics in higher quantity.

iii) As level dyebath is difficult in microfibre fabrics, a non-ionic levelling agent in the dyeing bath is preferable.

iv) To remove or avoid folding marks / crease marks / abrassion marks which are a common feature in microfilament fabrics, use of 1% (o.w.f) lubricant as anti-creasing agent should be added to the dye bath.

v) An effective deareator is also recommended and preferred over a defoamer in order to remove entrapped air, which otherwise may cause the goods (fabric) to float in the dye bath causing further uneven dyeing. In addition a good deareator will have firm suppressing properties and will also assist in the wetting of the fabric.Thus, a typical dyeing recipe for polyster microfilament fabric recommended[14] is as follows:

X gm	Disperse dyes (category of dyes is to be selected with care for level & solid dyeing)
0.10%	Setamol-WS (anionic dispersing agent)
0.20%	Wetting agent cum emulsifier
0.25%	Deaerator
0.50%	Levelling agent
1.00%	Anti-creasing (lubricant) agent
x%	Acetic acid (to adjust pH 4.5 to 5.0)

Use of 1.0 g/l Electro-fix LD-liquid (multi functional dyeing auxiliary) is also found to be useful. However control of dyeing temperature as shown in dyeing cycle-B or C (fig-1) should be followed for level dyeing of PET microfibre fabrics using properly selected dyes.

2.3.2.4 Care needed in selection of disperse dyes:

Proper selection of disperse dyes is very essential from double point of view (a) for obtaining level and deep shades and (b) for obtaining reasonably good wash and light fast shade; although both the above are difficult to achieve in polyester microfilament fabrics.

There are three major category of disperse dyes: i) low energy dyes, ii) medium energy and iii) high energy dyes, besides newer variety of dyes like low absorptive rapid diffusion (RDdyes) type.The low energy dyes have usually lower molecular weight and high migration rating, but low washfastness; while high energy dyes show better washfastness with low migration rating. So, for level shade in general, high migration dyes should be preferred. But for higher wash fastness, low migration dyes should be considered. Thus, it is difficult to choose disperse dyes for dyeing of microfilament polyester textiles. Again the practical dyeing behaviour of microfilament polyester textiles vary, depending on the fineness (denier per filament) of filament, percentage depth of shade and type of the disperse dyes along with the dye-structure of individual dyes and their adsorption characteristics, diffussion co-efficients and migration rating, etc. which are quite dye-specific.It is necessary to have a better dye- fibre affinity with dyes having high absorptivity, for good wash fastness properties. Higher dye exaustion property is required in the dyes for achieving deep shades. A preliminary study was therefore made to study the dyeing behaviour at different shade depth using different category of disperse dyes applied onto the PET microfilament fabrics and normal microdenier fabrics. Table 1&2 show the results of the relevant study on appropriate selection of different catagories of dispersed dyes.

Analysis of data from table-1 indicates that high energy –low migration dyes or rapid difussion –low absorption dyes show more level dyeing; the former type requires more time to reach equilibrium dyeing and the latter reaches the equilibrium dyeing within a very quick time period . The equilibrium dye-uptake trend for different category of dyes is found to be in the order:

low energy dye > medium energy dye > rapid diffussion dye > high energy dye

It has been reported in our earlier work[14] that low energy dye with high migration rating shows lesser difference in surface dye uptake as compared to high energy dyes with lower migration rating; i.e., for a level and solid shade, it is better to use high migration dyes. On further analysis of data from table-1, it can be understood that the practical amount of dye requirement for matching the depth of shade of microfibre with normal denier fibre fabric is comparatively much higher in case of low energy dyes which may be due to the fact that low energy dyes are relatively of lower molecular weight and can expectedly penetrate more into the core and therefore show less colour yield, while the other classes of dyes having higher molecular weight, expectedly diffuses less into the core which results in a comparatively higher colour yield on the surface showing less differences in shade depth between normal denier and microdenier polyester fabrics. Data from Table-2 also indicates that the difference inK/S value for all classes of disperse dyes is lesser for darker shades and the difference for any shade percentage is found to be comparatively lower in case of high the energy type and R-D type of disperse dyes. Hence high energy –low migration type or rapid difussion type disperse dyes is to be preferred for dyeing microdenier polyester fabric, table-1

It is reported in literature that microfibres have more amorphous content than normal denier fibres and hence weight reduction treatment[10] is more vigorous for microdenier polyester fabrics. It can be observed from the data in table-2 , that the proportional difference in K/S values between normal denier and micro-denier PET fabric are more predominant in case of lighter shades than deeper shades. After a certain shade depth, the saturation of the dye in the amorphous region occurs, which in turn reduces the difference in quantity of the dye required to dye both the microdenier and normal denier polyester fabric to nearly equal depths. However, there is difference in the scattering property of microdenier filaments compared to the normal denier filaments, owing to more surface area of microdenier filament and hence the latter shows differences in shade percentage even after saturation.

3 SOME SELECTIVE STUDIES FOR IMPROVING SURFACE DEPTH OF COLOUR AND LIGHT FASTNESS FOR MICRO DENIER POLYSTER FABRIC:

3.1 Effect of some selective dye-bath additives:

Table-3 shows some data on the effect of application of three types of dyebath additives added to the dyebath during dyeing of both normal denier (2.14 dpf) and microdenier (0.80 dpf) polyester fabrics, with the recipe mentioned in sub section 2.3.2.3, following dyeing cycle 'C' (shown in fig-1). Relevant results indicate that for 1% shade depth all the three additives show a marginal improvement in the depth of shade (K/S value or surface colour strength) for both microdenier and normal denier polyster fabric.The differences in K/S values between corresponding normal denier and microdenier dyed PET fabrics reduces to the maximum extent in case of application of 2% (o.w.f) amino-silicone as dyebath additive (also showing maximum colour differences from the corresponding control sample). It is also observed that when 0.5% Benzophenone, (uv-absorber) is added to the dyebath, noticeable improvement in light fastness of both normal and microdenier dyed polyster fabric takes place, while the antioxidants (lauryl-thio-di-propionate) has little effect in improving the light fastness. The noticeable increase in colour yield by application of 2% (o.w.f) amino silicone maybe due to the change in scattering value of the dyed surface, as the film of amino-silicone formed on the dyed surface by expectedly maximum exhaustion of amino-silicone at high dyeing temperature of 130°C (which is a curing temperature for amino-silicone finish) along with amino-silicone's contribution on dyed surface allowing less reflection of light due to its lower refractive index (1.43) than the refractive index of polyester fibre (1.63). Some more detailed information has been reported in our earlier study[14], regarding increased dosages (0.5 to 2%) of Benzophenone added to the dyebath which shows better photostability, as revealed from the curves in fig-2, which shows the photo fading behaviour at different hours of exposure to MBTL-microscal fade-O-meter (SDL).

3.2 Effect of solvent pretreatment before dyeing

It has been reported in our earlier work[14] that treatment of microdenier polyester (before dyeing) with 10 to 20% aqueous solution of Phenol at room temperature for 60 min. shows 2 to 2.3% weight loss and around 12 to 21% improvement in surface colour strength (K/S values) when subsequently dyed with disperse dyes. Treatment with 10% aqueous DMF and 10% Nitrobenzene in Trichloroethylene media, show 1.5 to 1.9% weight loss and approximately 10 to 14% increase in the K/S value for microdenier fabrics. Use of 100% DMF as pretreatment medium, shows 2.44% weight loss and about 18% increase in K/S value for microdenier polyester fabric. Solvent pretreatment with a mixture of Xylene : DMF (1:2) for 60 min. at room temperature ($30 \pm 2^{0}C$), shows 2.85% weight loss and 32.7% increase in K/S value for microfilament PET fabrics and hence, this method of treatment maybe useful for improving surface depth of colour on microdenier polyester fabric.

3.3 Effect of some aftertreatments by selective finishing chemicals, with or without suitable chemical additives

A number of physio-chemical processes have been reported in literature[18-20] to modify PET microfibre fabrics in order to improve its surface depth of colour without further increase in dye uptake, by aftertreatment of dyed microfibre polyester fabrics with chemicals of low refractive index such as silicones, fluoro carbon and polyurethane resins or by treatment with slow discharge to roughen the surface etc. However there is ample scope to explore such chemical after treatments in more effective way to derive benefit by improving surface depth of colour and to improve light fastness simultaneously by suitable treatments. This section is a report on such an endeavour.

Table 4, shows that there is measurable increase in the surface depth of colour of microdenier polyester fabric when a polymeric finishing agents having lower refractive index than that of the polyester fibre, i.e.amino-silicone emulsion, is applied to the normal and microdenier dyed polyester fabrics by pad-dry-cure method. Approximately 11% increase in surface strength colour (K/S value) for 2% application of amino-silicone emulsion is observed. This increase in colour yield after finishing with silicone emulsion is due to its lower refractive index than that of the polyester fibre, as discussed earlier,in section 3.1. With an aim at improvement in light fastness when 0.1% of LTDP as an antioxidant and 0.1% benzophenone as uv - absorber is applied alongwith silicone emulsion, by pad-dry-cure technique, it is observed that the light fastness is also increased noticeably (about1 to1.5 grade rating is improved) without affecting the improvement in depth of shade of both the microdenier and normal denier polyester fabrics. However, the improvement in light fastness observed after the addition of these chemical additives (antioxidant and uv-absorber) along with amino-silicone emulsion, thus compensates the effect of small reduction in the improvement of the K/S values by the effect of only amino-silicone emulsion application.

4 CONCLUSION

4.1 For effective preparatory chemical processing of microdenier polyester fabrics, different precautions and measures have been suggested in section 2.2 and have to be followed with great care.

4.2 For dyeing problems of microdenier polyester fabrics, different corrective measures suggested in sub.sections 2.3.2.1 to 2.3.2.4, including recommended dyeing cycle, dyeing recipe with suitable auxiliaries, dyeing machinery selection, and suitable dye selection are very important for obtaining level dyeings.

4.3 Use of 0.5% Benzophenone as an additive in the dyebath shows encouraging results in obtaining better light fastness and some improvements in the K/S values for both microdenier and normal denier PET fabrics.

4.4 Use of solvent pretreatment of microdenier polyester fabrics shows another alternative route to get improved surface depth of colour on it. Solvent pretreatment using a mixture of xylene : DMF(1:2) for 60 min at room temperature as pretreatment of microdenier PET fabric shows significant improvement in surface depth of colour, which maybe very useful..

4.5 Post-treatment with 2% amino-silicone emulsion along with 0.1% LTDP or 0.1% Benzophenone by pad-dry-cure method shows a good improvement in light fastness of disperse dyed polyester microdenier fabric.

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Fig 1

Typical Comparative Dyeing Cycles for normal Denier and microdenier Polyester

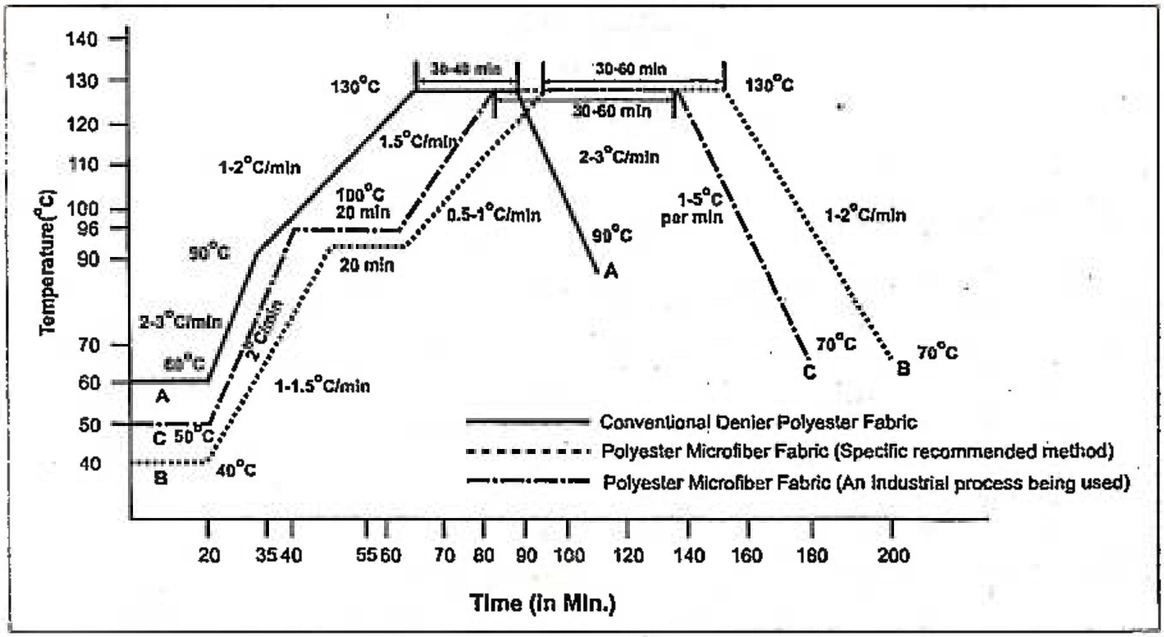

Fig 2

Fading Behaviour (in terms of K/S) for different hrs. of fading of dyed microdenier PET fabric treated with Benzophenone (uv-absorber) applied in dyebath

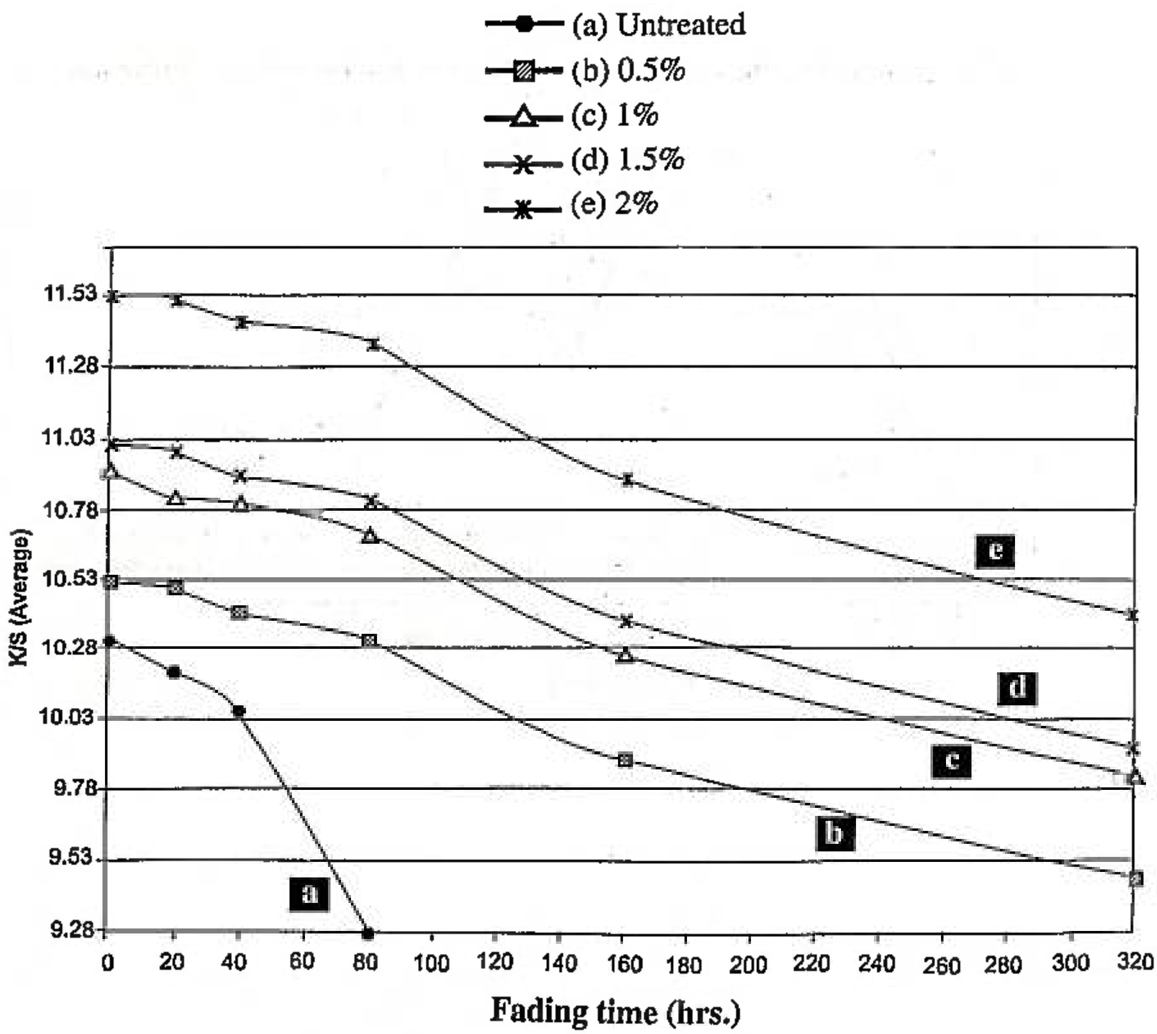

Table 1 : Different in depth of shade (for 0.5%) on normal and microdenier PET fabric using various classes of disperse dyes and actual dye required for matching the shade depth of microdemier fabric with the shade of normal denier fabric.

Class of Disperse Dye	Name of the Dye	λ max	K/S value for 0.5% shade		Diffe-rence in K/S value	Total CIE colour differ-ence (ΔE)	Relative colour strength of microde-nier in comp-arison to normal denier	Computer calculated parts required on the basis of colour match formula-tion programme	Practical observed parts of dye required to match the shade	Match quality after practical matching for 0.5% shade (K/S)		Colour difference of microdenier in comparison to normal denier PET				Light Fastness Rating (IS-2454-1967)		Wash Fastness Rating (ISO-II)	
			Normal Denier (2.14 dpf) a	Micro Denier (0.80 dpf) b						Normal Denier	Micro Denier	(ΔE)	(ΔL)	(Δa)	(Δb)	Normal Denier	Micro-Denier	Normal Denier	Micro-Denier
Low Energy Dyes mole-cular weight (range : 200-250)	Disperse Red B2B (CI Disperse Red 60)	520	0.99	0.79	0.20	1.141	79.98	125.03	192.53	0.99	0.99	1.203	-0.442	-1.098	-0.215	5.0	3-4	4-5	3-4
	Palanil Yellow 3 G (CI Disperse Yellow 64)	440	1.16	0.95	0.21	1.287	82.12	121.78	242.21	1.16	1.16	1.279	0.152	0.726	1.042	4-5	3-4	4-5	4.0
	Navience Blue 2RX (CI Disperse Yellow 64)	640	1.04	0.74	0.30	1.298	71.75	139.37	182.63	1.04	1.03	1.302	-0.100	-0.565	1.169	5	3-4	4-5	3-4
Medium Energy Dyes molecular weight (range : >250<300)	Disperse Magenta FD-BN	520	1.17	0.91	0.26	1.355	74.63	118.16	116.91	1.17	1.17	0.506	-0.209	-0.457	0.056	5-6	4-5	4-5	3-4
	Dispese Yellow FD-6G	440	1.26	0.97	0.29	0.894	76.53	130.67	171.57	1.26	1.27	1.009	-0.761	0.514	-0.418	5-6	4-5	4-5	3-4
	Disperse Violet FD – 4 RL	580	1.14	0.91	0.23	2.870	80.16	124.74	184.02	1.14	1.15	0.358	-0.077	-0.348	0.037	5	4-5	4-5	3-4
High Energy Dyes molecular weight (range >300 to 400)	Rathilence Red 3 BLS (CI Disperse Red 167)	520	0.96	0.78	0.18	0.872	81.79	122.27	186.29	0.96	0.96	0.392	0.191	-0.296	-0.172	5-6	5	4	4
	Rathilene Yellow 5 GL (CI Disperse Yellow 198)	440	0.93	0.72	0.21	0.993	77.57	128.91	188.11	0.93	0.93	0.889	-0.307	0.518	-0.075	5-6	5	4-5	4
	Tulasteron Nevy Blue 2 GDN (CI Dispersed Blue 79)	620	1.14	0.95	0.19	1.099	82.97	120.53	169.20	1.14	1.14	1.064	-0.189	-1.283	-1.283	5-6	5	4-5	4
Rapid Diffu-sion Dyes	Foron Navy RD RLSI	640	0.98	0.80	0.18	1.252	81.63	122.57	139.80	0.98	0.97	0.902	0.038	-0.727	-0.532	5-6	4-5	5	4
	Foron Yellow RD 4GRLI	440	1.16	1.00	0.16	1.132	86.20	116.12	143.40	1.16	1.16	0.736	0.175	-0.130	0.703	5-6	4-5	5	4

Table 2 : Difference in depth of shade on normal denier and microdenier polyester fabrics for medium and high energy and R-D class of disperse dyes, for different shade percentage

Type of Disperse Dye	Shade (%)	K/S		Relative colour strength	Difference in K/S value in between a pair of corresponding shade of normal & microfibre fabric
		Normal	Micro		
1. Medium Energy Dye(Gr.II) (Disperse Yellow FD6G)	0.5	1.26	0.97	78.46	0.29
	1.0	1.51	1.33	88.07	0.18
	2.0	1.56	1.41	90.38	0.15
	3.0	1.59	1.47	92.45	0.12
	4.0	1.61	1.49	92.54	0.12
	5.0	1.62	1.50	92.59	0.12
2. High Energy Dye (Gr.III) (Rathilene Yellow 5GL)	0.5	0.93	0.72	84.78	0.21
	1.0	1.11	1.00	90.09	0.11
	2.0	2.25	1.14	91.20	0.11
	3.0	1.34	1.26	94.02	0.08
	4.0	1.38	1.30	94.20	0.08
	5.0	1.39	1.33	95.68	0.06
3. Rapid Diffusion Dye (R-D; Gr.IV) (Foron Yellow RD4GRLI)	0.5	1.16	1.00	86.20	0.16
	1.0	1.35	1.22	90.37	0.13
	2.0	1.49	1.38	92.61	0.11
	3.0	1.57	1.47	93.63	0.10
	4.0	1.61	1.53	95.03	0.08
	5.0	1.63	1.57	96.31	0.06

Table 3 : Effect of some additives (amino-silicone, uv-absorber, antioxidant, etc.) in the dye bath (Disperse Red B2B), shade depth – 1%)

Dyeing Additives	K/S	Difference in K/S value (a-b)	Relative colour strength, as compared to normal denier control sample	Total CIE colour difference (ΔE) from corresponding control sample	Light fastness rating (IS-2454-1967)
No additive (CONTROL)					
a. Normal deiner	1.39	—	100	—	5
b. Microdenier	1.19	0.20	85.61	—	3-4
0.5% (o.w.f.) antioxidant (Laury-thio-di-propionate)					
a. Normal deiner	1.42	—	102.15	1.521	5
b. Microdenier	1.22	0.20	87.77	1.339	4
0.5% (o.w.f.) uv-absorber (Benzophenone)					
a. Normal deiner	1.45	—	104.32	1.818	5-6
b. Microdenier	1.28	0.17	92.09	2.552	5
0.5% (o.w.f.) amino-silicone emulsion (applied by exhaust method)					
a. Normal deiner	1.47	—	105.75	2.806	4-5
b. Microdenier	1.32	0.15	94.96	3.395	3-4

Table 4 : Effect of application by pad-dry-cure of different polymeric finishing agents on the depth of shade and light fastness of dyed normal denier and microdenier polyester fabrics10.

Type of Finishing (applied by pad-dry-cure)	K/S	Total CIE colour difference (ΔE) for corresponding control sample	Relative colour strength as compared to normal denier control sample	Light fastness rating (IS-2454-1967)
No treatment (CONTROL)				
a. Normal deiner	1.39	—	100	5
b. Microdenier	1.19	—	85.61	3-4
2% amino-silicone emulsion				
a. Normal deiner	1.50	2.362	109.90	4-5
b. Microdenier	1.34	0.821	96.40	3-4
2% amino-silicone emulsion & 0.1% Laury-thio-di-propionate (antioxidant				
a. Normal deiner	1.45	0.451	106.65	5-6
b. Microdenier	1.28	1.554	92.08	5
2% amino-silicone emulsion & 0.1% Benzophenone (uv-absorber)				
a. Normal deiner	1.48	0.544	107.93	6
b. Microdenier	1.27	0.865	91.36	5

DEVELOPMENTS IN TEXTILE CHEMICAL AUXILIARIES

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Abstract

Significant developments have taken place recently in the field of textile dyeing and printing together with constant introduction of newer and more efficient auxiliaries which aid in providing excellent finishing at minimal cost. The problems faced by the knitwear industry in Kolkata in relation to processing (namely, scouring, dyeing and printing) together with their solutions have been briefly dealt with in this paper.

1 INTRODUCTION

In recent times, we have seen a growing awareness among the textile dyeing and printing units, specially in Kolkata, regarding the importance of extremely high standards to be maintained at all levels of textile processing. These challenges primarily point towards all round fastness properties (fastness to washing, fastness to light, wet-rubbing fastness, etc., to name a few), accurate shade matchings and exact reproducibility of shades without any variation from one batch to another, to the fabric GSM and stretch property after processing and high quality textile finishing. Further, this needs to be blended with the eco-friendly concept by using azo free dyes and chemicals.Thus, textile processing today, is no longer an easy game.

Most of the textile processing units in India still use '*desi*' and outdated techniques for dyeing and finishing. Colour matching is achieved simply by mixing dyes by trial and error method. Further, most of the dyeing houses do not have enough steam power in their boilers / the boiler capacities are low; this results in poor scouring and hence poor dyeing (since the dyes cannot penetrate the hydrophobic fabric leaving a lot of dyestuffs unutilized in the dyebath). This also leads to poor fixation of the dye and subsequently poor dye fastness.

In order to compete and survive in the international textile market, one has to adopt latest techniques in processing and here the development and use of different textile auxiliaries could play a major role.

2 DEVELOPMENTS IN AUXILIARIES IN DYEING

The dyeing units in Kolkata have recently realised the importance of high quality dyeing; no wonder some of the units have started converting their winches into soft flows! There is a growing awareness regarding all round fastness properties of dyed textiles among the processing houses. A lot of attention is also being directed to the finishing of textile products to enhance their aesthetic / performance properties.

Problems associated with the dyeing of knitted garments can be categorized into the following heads:

a) Problems related to scouring.

b) Problems arising during the dyeing sequence.

c) Improper / absence of appropriate finishing treatments.

2.1 Problems related to Scouring

Scouring is a general term used to refer to the removal of foreign matter or soil from the fabric prior to finishing and dyeing in order to render the fabric more absorptive. The foreign matter involved may be processing oils, starch, natural waxes and tints or colour added to aid in fibre identification during production. Common scouring chemicals are soaps / detergents.

The root cause of most of the problems related to dyeing namely, unevenness, patchiness, presence of streaks, and others, lies in inefficient scouring of the textile material before dyeing. However this can be overcome through the use of high performance / quality chemical auxiliaries.

For scouring of cotton knitwear in soft flow machines, a detergent, popularly known as "Jet" is widely used. It is a high powdered detergent with good wetting and low foaming action. It helps in thorough cleaning of the grey fabric along with removal of stains, oils, starches and others. It also increases the absorptivity of the fabric which further aids in complete penetration of the dye during the subsequent dyeing process thereby ensuring excellent levelled results. Another advantage of this "Jet" is that, in addition, it also provides the necessary lubrication which is much required for the smooth running of the fabric without any tension in the soft flow machine. This in turn prevents any crease marks on subsequent colouration of the scoured fabric.

Attempts are also being made to introduce enzymes for quicker and efficient scouring of cotton knitwear.

2.2 Problems arising during the Dyeing sequence

The main problems faced by most dyers is uneven shades, difficulty in shade matching from one lot to another and poor penetration of the dyestuffs into the fibre structure resulting in poor overall fastness of the dyed products.

It is essential that the dyeing of any textile material results in level shades. When the dyeing is solid and even, it gives an added visual fineness to the fabrics, which satisfies the consumers. There are factors which cause uneven dyeing and, to remedy the situation, levelling agents have been developed to play a suitable role to bring about level shades. As the chemistry behind dyeing is different for different fibres, different levelling agents are required for fibres which differ in their dyeing behavior and property.

Water is used in large quantities in textile wet processing including dyeing, specially is used in the preparation of solution of dyes. It is very important to use water which is free from objectionable impurities otherwise trouble may arise in the wet processing operations. If hard water containing impurities; else, uptake in the form of calcium and magnesium salts is used in the washing operations, it does not form lather with soap and deposits insoluble "lime soaps" on the goods, which in turn render the material impermeable to subsequent treatments. Basic dyes form insoluble precipitates with calcium and magnesium salts present in water, resulting in loss of colouring matter and faulty dyeing. Direct dyes are also affected in a similar way. Naphthols give turbid solutions with hard water leading to weak and faulty dyeings. Vat dyes form insoluble substances with their leuco compounds when vatted in hard water, which have no affinity for the fibre. Yarns dyed in hard water also dust and run badly on the winding machine. Similar difficulties arise in dyeing with sulphur dyes or reactive dyes if hard water is used. Thus, in order to overcome the problems associated with hard water during dyeing, a sequestering agent is added to the dye liquor (about 2%). This agent will make the water soft, a state in which the dye molecules can penetrate the fibre structure more easily, thereby ensuring levelled solid dyeing.

Further, for achieving the desired depth of shade using reactive dyes by the exhaust method, Glauber's salt is recommended as the exhausting agent instead of common salt.

2.3 Finishing of Dyed Fabrics

Finishing is the final operation in a process house and aims at enhancing the appearance, attractiveness and brightness of the fabric. The feel or the hand is to be improved by imparting softness, suppleness, smoothness and providing body to the fabric as well as drape. Finishing can also confer some useful wearing properties such as wrinkle recovery, pilling resistance, slippage resistance, wear resistance, etc. it can also impart specially required properties for specific end uses such as fire repellence, water repellence, rot proofing, moth proofing, and others.

Fabric softeners were developed to improve the hand of harsh textiles, which may result due to the effect of the chemicals used in dyeing or finishing treatments. Generally, softening of the fabrics is carried out towards the final stage of wet processing. Softening agents are applied to processed fabrics to improve their hand, drape, cutting and sewing qualities.

Among the various softeners, the cationic softeners are preferred because they can be applied by the exhaust method as compared to the anionic and non ionic softeners which have to be padded on to the fabric.These cationic softeners have an affinity for the fibre. Although they have a tendency to yellow with age, non yellowing varieties are available. Most of these softeners contain quarternary ammonium compounds, and these compounds may confer some incidental anti bacterial properties as well.

The best results are however obtained when the non-yellowing cationic softeners are topped with the non-ionics / silicones or micro-silicones; the cationic softener imparts bulkiness and overall softness to the fabric, while the silicone gives a greasy/ silky feel to the fabric surface.

Currently, enzymes are also being used for imparting softness to the dyed fabric; however it is an expensive method and requires much expertise as well.

In silk dyeing high power silk dyes which are easy to dye and at the same time give high brilliancy of shades, have also been introduced.

3 DEVELOPMENTS IN AUXILIARIES USED IN PRINTING

. The important ingredients in a printing paste are the colouring matter, thickener, binder (in case of pigment colours) and a number of auxiliaries. A large number of innovative products are constantly being added into the field of textile printing. Apart from the usual pigments and 'khadi' used as colourants in printing of textiles, gold, silver and copper dust powders, imported from Germany and Switzerland have also been introduced into the Indian market. This has made it possible to produce the so called "poor man's Benarasi Sari". Prints with these metal dusts give a very low cost close imitation to the highly priced brocades of Benaras. A large number of glitters too have been introduced into the market and these have been widely accepted in "chest printing" of T-shirts as well as saris. Further, foam and "pearl" printing have also become immensely popular today.

Binders is the most important ingredient used in pigment printing. It is a film with forming material high molecular weight. The fastness to washing, rubbing, dry cleaning, bleaching and perspiration depends upon the binder. It forms a film on the surface of the fabric, on drying and curing; there is no chemical bonding between the binder and the fibre but only a physical bond exists between the two. Today, many low cost binders are available which need not be mixed with MTO and kerosene; they are popularly known as "water binders". These binders are thus cost effective, environment friendly and easy to apply.

Thickeners are used in printing in the form of paste or emulsion in order to prevent spreading of the dye beyond the boundaries of the design and to hold the dye particles in the printed portion until they are fixed onto the fabric. The different thickeners used for printing different fibres are as follows:

i) Cotton: Neutral white gum (NAH5O) to be fixed with sodium silicate at pH 6 to7.

ii) Silk: Low viscosity gum (UBV) to be mixed with 10 litre of water/ kg of thickener.

iii) Polyester: AGBV thickener

4 CONCLUSION

This country has immense potential to become a leader in finished cotton textiles and knitted garments. If we combine latest processing techniques with trained personnel and take up adequate R&D in the field of textile auxiliaries, then we can play a major role in the field of textile processing. For this, we have to face all the challenges with vigour and emerge a world leader in processed cotton textile knitwear.

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