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6 January 1988
ENGLISH

JUTE RESEARCH AND DEVELOPMENT

DP/IND/86/037/11-01

INDIA

Technical report: Second mission report*

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

Based on the work of R.R. Atkinson
Technical Co-ordinator

Backstopping officer: A. Erăneva, Agro-based Industries Branch

United Nations Industrial Development Organization
Vienna

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C O N T E N T S

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JUTE RESEARCH AND DEVELOPMENT

DP/IND/86/037

Indian Jute Industries Research Association

Calcutta

23-26 October and 6-21 November 1987

REPORT ON SECOND MISSION

The report gives an account of the progress made at IJIRA since the last visit and during the present one. Briefly, this has been

- three out of five study tours completed.
- 90% of the laboratory equipment has been ordered
- most of the pilot plant has been identified and neutral specifications are being drawn up.
- six Experts have been identified
- most of the Fellows have been selected
- the project office is complete and manning has started
- new project laboratories are ready for construction
- most of the project staff have been selected and will be taken on site as required
- terms of agreement between IJIRA and the mills for pilot plant have been finalised
- terms of reference for three sub-contracts have been agreed

The following actions are required:-

Technical Co-ordinator

1. Contact Shirley Institute re Dr Muhkopadhya's letter regarding a visit and training in instrumentation.

2. Contact Clemson University's Business School and Scottish College of Textiles regarding the provision of an Expert in industrial engineering.

3. Visit AERE Harwell for discussions with Dr Bowen re sub-contract and recommendations for equipment for jute re-inforced plastic.

4. Try to locate a suitably qualifed maintenance engineering Expert.

UNIDO

1. On receipt of Fellows Nomforms proceed with training arrangements.

2. Contact those Experts already identified for possible contracts.

3. Contact the institutes selected for sub-contracts.

4. On receipt of Purchase Requisitions for pilot plant and the remainder of the laboratory equipment, call for quotations and specifications.

5. Arrange for CTA to visit IJIRA in March/April 1988

IJIRA

1. Present Fellows Nomforms to Government as soon as possible.

2. Complete all outstanding Purchase Requisitions for pilot plant and laboratory equipment.

3. Communicate Terms of Agreement for pilot plant to the respective mills.

4. Commence building work for new laboratories.

5. Arrange outstanding Study Tours.

It is expected that by the CTA's next visit in March/April 1988 the above items will have either been completed or substantinal progress made upon them as well as general progress in line with the Work Plan for the project.

STUDY TOURS

The tours of the Head of Applied Chemistry Division and the Mechanical Processing Division were completed successfully. The locations visited were:-

Applied Chemistry:

Benniger AG, Zurich
ITC and JMDC, Brussels
Longclose Ltd, Leeds, UK
UMIST, Manchester, UK
Textile Research Inst.,Princeton,USA
Personal Products, New Jersey, USA
ITC and JMDC, Atlanta USA

The subjects covered were inspection of dyeing and bleaching machinery, possible locations for Fellowships and sources of Consultants, fibre softening by chemicals

Mechanical Processing:

Textile School,Clemson University,USA
JMDC, Atlanta
Mackie & Co Ltd, Belfast,UK
Lambeg Industrial Research Assn, N. Ireland
Samco Strong Ltd, Leicester, UK
Schlumberger, Guebwiller, France
Union Special/ Carl Schmale, Stuttgart W Germany

The subjects covered were machinery for blending jute and other fibres, cloth cutting and bag sewing on automated lines, location of a suitable institution for sub-contract on blends and fabric engineering

Reports on these tours have been submitted. The Heads of Physics and Biology are currently preparing their tours.

EXPERTS

It is proposed to use the following visiting experts:-

Enzyme softening of fibre

Post 11-02

Either (first choice)

Dr S K Niyogi
Biology Division
Oak Ridge National Laboratories
PO Box Y
Oak Ridge
Tenessee 37831
USA

or (second choice)

Professor Tengardy
Colorado State University
Fort Collins
Colorado
USA

Chemical softening of fibre

Post 11-03

Dr P K Chatterjee
Personal Products Inc
Johnson & Johnson
Milltown
New Jersey
USA

Blending and fabric engineering

Post 11-05

Dr B C Goswami
School of Textiles
Clemson University
S Carolina
USA

Jute reinforced plastics

Post 11-09

Dr D Bowen
Material Development Division
AERE
Harwell
Oxfordshire
UK

Textile chemistry (bleaching and dyeing)

Post 11-13

Either (first choice)

Prof L W C Miles
Dept of Textiles
UMIST,
Manchester,
UK

or (second choice)

Prof Sarkenen
University of Seattle
Seattle
USA

Geo-textiles

Post 11-16

Either (first choice)

Mr J Thomson
Jason Consultants
15 Rue du Cendrier
1121 Geneva
Switzerland

Or (second choice)

Civil Engineering Dept (no person identified)
Queens Unversity
Belfast
N Ireland

The CV's of these experts (where available) are given in Annex 1. The remainder of the experts will be identifed at soon as possible.

LABORATORY EQUIPMENT

Some $400 000-worth of equipment has been selected and ordering procedures begun. This covers most of the items foreseen but a further $20 000 or so will be required for equipment for the Physics Division and $10 000 for Chenistry. Requisitions for these latter items can be expected in Vienna soon.

PILOT PLANT

Neutral specifications have been prepared and the project now awaits catalogues and quotations for:-

Intersecting gill-boxes

Ring spinning frame
Fibre/yarn bleaching and dyeing machine
Automatic sack sewer
Stenter
Jigger

Enzyme culture plant

Following the first mission report, further discussions have been held with microbiologists in India regarding the most suitable type of culture plant. As a results of these meetings, a possible plant has been found at

Central Food Technological Research Institue
Mysore 570 013
India

This Institute, in its Fermentation and Bioengineering Department, has developed a solid state fermentor which may be suitable for the production of the enzyme required for this section of the project, namely improving the textile properties of low grades of fibre. IJIRA has arranged to carry out trials on the plant and. if these are successful, a 100 or 200 kg capacity plant will be purchased. Nevertheless, it is felt that contact should still be made with the French institute, IRCHA, discussed in the first mission report so that the very best expertise and equipment can be selected.

Form of Agreement

The draft of the Form of Agreement between IJIRA and the mills where the pilot plants will be located has been amended and the final form is given in Annex 2. This final draft is now in the hands of IJIRA's lawyers for comment.

STAFF

All project staff have now been selected. Half are from IJIRA itself and half from outside. Work allocations and

joining dates are being synchronised with the progress made so far in the project. The first secretarial staff are on site now and the others will join according to the programme laid down by the National Project Director.

Accommodation

The project office is now ready and in use. Municipal approval has been given for the additional laboratories and work is expected to begin shortly.

WORK PLAN

The work plan given in the first mission report has been modified slightly. All marketing acivities will not start until March 1988 at the earliest becuase the Project Advisory Committe felt that no useful work could be engaged upon if staff and Experts were recruitred too early in the project.

The Committee decided that the next visit of the CTA snould be made in March/April 1988 rather than wait until July as shown in the work plan. The CTA should still come to IJIRA in July for the first tripartite review.

PROJECT ADVISORY COMMITEE

A meeting of the Committee was held on 13 November 1987, attended by

Mr S R Basu, Jute Commissioner
Mr M Islam, UNIDO SIDFA
Mr G Sivaraman, Chairman IJIRA
Dr S R Ranganathan, National Project Director
Mr R R Atkinson, UNIDO CTA

Minutes will be issued in due course from IJIRA.

FELLOWSHIPS

The following Fellows have been selected and their Nomination Forms sent to the Government of India for clearance prior to processing by UNIDO Training Branch.

Bleaching and dyeing - 3 months at UMIST. Manchester. Dr T K Guha Roy - contact Prof L W C Miles

Chemical softening of jute - 2 months at Personal Products, Johnson & Johnson, Milltown, New Jersey. Mr P S Battacharya - contact Dr P K Chatterjee

Microbiology - 3 months at Oak Ridge National Research Laboratories, Oak Ridge, Tenesee. Dr S N Sinha - contact Dr S K Niyogi

Jute reinforced plastics - 6 months at AERE, Harwell, Oxfordshire, UK. Mr P K Pal - contact Dr D Bowen

Fabric engineering - 3 months at Clemson University, S Carolina USA. Dr U Dutta - contact Dr B Goswami

Blending - 3 months at Clemson University S Carolina USA
Mr N Chattopadhay - contact Dr B Goswami
Mr P K Chatterjee - contact Dr B Goswami

Fellows and locations for physics/instrumentation have yet to be selected.

LIAISON VISITS OUTSIDE INDIA

In connection with the automated sack and bag sewing line two visits were made with the Head of the Mechanical Processing Division to have discussions with manufacturers who might be interested in developing such equipment. The first, Samco Strong of Liecester UK, offers a good cutting line but has no sewing while the second, Union

Special/Carl Schmale of Suttgart, has cutting and sewing capability. At this juncture, it looks as though the German company(ies) may be able to develop this item for IJIRA and a quotation is awaited from them. Details of the visits are to be found in Annex 3.

SUB-CONTRACTS

TERMS OF REFERENCE

Subcontracts, presented in draft in the first mission report, have been finalised for the following subjects:-

Fabric engineering and jute blends.	Suggested site, Clemson Universtity, USA
Jute reinfored plastics	Suggested site AERE, Harwell, U.K.

NOTE: Although there is no provision in the Project Document for a sub-contract in jute geo-textiles, there is such provision for a visitng Expert. A Job Description for this person has been written but as the possible choice of Expert is a member of a consultancy firm it may be that some form of sub-contract will be needed with them so that the Expert may be used. Both Job Description and Terms of Reference have been included in this report to cover this eventuality.

The details of the sub-contracts are given in Appendix 4

APPENDIX 1

CV'S OF VISITING EXPERTS

Curriculum Vitae (1986)

Dr. D. H. BOWEN

Date of Birth: 3rd May 1928

Education and Degrees awarded:

B.Sc.(Hons), University of London - 1956
Ph.D. Physics, University of London

Membership of Professional Societies:

Member of Institute of Physics
Member of Plastics & Rubber Institute

Previous career to Harwell:

1957-1961 I.C.I. Research Fellow, University of London.
- Magnetic properties of Ni-Pd alloys.
- Development of helium liquifaction techniques.
- Teaching

1956-1957 Mary Amanda Wood Research Fellow, University of Pennsylvania.
- Effect of pressure on the superconducting transition temperature.

1954-1956 Research Student - University of London.
- Superconducting properties of S and Pb.

Present post at Harwell:

Banded Officer, Group Leader, Polymer & Composites Group, Materials Development Division.

Research Experience and Current Activities:

1971-present In charge of group comprising 35 staff concerned with R & D in plastics and composites related to Harwell's nuclear and industrial contract research programmes. Group topics include:

- Development of carbon fibres with special properties, characterisation of carbon and Kevlar fibres, development of test methods for high performance composites.
- Studies of failure mechanisms in composites - particularly under transverse and torsional stresses.
- Development of advanced filament winding techniques for CFRP components.
- Development of testing techniques for adhesive joints between composites and between metals and composites.

- Development of fibre reinforced elastomers with special properties.
- Investigation of failure mechanisms in continuous fibre reinforced thermoplastics.
- Properties of vegetable fibres.
- Development of Composite aerospace and automotive components.
- Studies of composite materials for use in spacecraft.
- Radiation damage studies in polymers and elastomers.
- Lifetime prediction for seals and polymeric waterproofing membranes in nuclear plant.
- Studies of degradation mechanisms in irradiated paint films on concrete.
- Investigations into the potential use of polymers and polymer-modified cements for the immobilisation of radioactive wastes.

1966–1971 Head of Non-fissile Ceramics Group, Harwell. Group topics include:

- Radiation damage mechanisms in ionic crystals.
- Development of fibre reinforced ceramics.
- Development of fibre reinforced hydraulic cements.

1961–1966 Research Scientist, Harwell.

- Mechanical properties of single crystal ceramics.
- Radiation damage studies in ionic crystals.

Other: Advisory Editor, Composites Journal
Founder member - British Composites Society.

1978 and 1979 Visited Indian research establishments as overseas expert on carbon fibre technology as part of UNDP programme to stimulate composite materials development in India. - Project coordinator Mr. G. Lubin - Grumman Aircraft Corporation.

1979–1981 Carried out research at Harwell on the development of jute-based composite materials in collaboration with the Indian Jute Industries Research Association in a programme funded by the Commonwealth Fund for Technical Cooperation. Programme also involved training of Indian scientists at Harwell in composite materials technology.

THE HARWELL LABORATORY

Harwell is the main research laboratory of the United Kingdom Atomic Energy Authority (UKAEA). Since 1965, in addition to its nuclear work, Harwell has carried out a steadily expanding programme of contract research and development work for industry and agencies in the U.K., Europe and the U.S.A. So successful has this diversification been that Harwell is now the largest multi-disciplinary research and development organisation in Europe, deploying some 54% of its 1,150 professional scientists and their support staff on contract research and development work for about 1,000 major customers each year. In 1984/5 the revenue earned, from contract research and development totalled £50M out of a total turnover of approximately £95M.

Curriculum Vitae

L.W.C. Miles

Date of birth: 29 June 1928

1939 - Foundation Scholarship to Brentwood School.

1945 - Royal Scholarship to study chemistry at Imperial College.

1948 - B.Sc. Hons.

1950 - Ph.D. for research in the field of organic chemistry.

1950-61 - Employed by Tootal Ltd. in technical development. Planned and managed a new dyehouse and a new printing department. Left when no new developments were expected.

1961 - Appointed lecturer in Textile Chemistry, with responsibility for the dyehouse. At that time I had 3 Burnham scale senior teachers and 5 technicians to run the dyehouse courses.

Academic and professional standing

My experience in the industry had taught me that it was in the 'chemical engineering' of textile processing that the important problems and the key to profitability lie. My research has, therefore, been almost entirely directed towards a better understanding of the mechanisms and the control of practical processes. These are difficult, multi-disciplinary areas for study and the processes have many variables. Better techniques are now available for such studies.

Useful contributions have been made in at least seven different areas.

1. An experimental study of the movement of solutes (migration) during the drying of textile fabrics, and in a model system, opened up an important field. The contribution of diffusion as a secondary mechanism of re-distribution (in addition to capillary movement) was demonstrated for the first time.
   McDowell and Miles, JSDC 82 (1966) 414 and 447.

2. In order to apply the above to the understanding of the particular process of crease-resist finishing, it was necessary to work out a technique for measuring diffusion rates in cellulose over a range of moisture content. This was done successfully, for the first time, and the student has applied the technique in his subsequent work, in Egypt. Our paper has been frequently quoted as a pioneer publication.

3. In a study of the effect of swelling processes on the accessibility to dyes of cotton yarn, evidence of mono-layer sorption was observed. This was unexpected but has been confirmed and has helped to change the interpretation of cotton fibre structure and dyeing mechanism.

   Johnson, Maheshwari and Miles, Institut Text. France Sirtec 1969, 558.

4. When the use of non-aqueous solvent for dyeing was being investigated, I started a study of a solvent/non-solvent mixture system. For the application of reactive dyes this could be useful. The student has developed this approach in subsequent work, in India.

   Chavan Ph.D. Thesis 1974, JSDC 92 (1976) 59; TRJ 53 (1983) 347.

5. The printing and fixation of dyes by techniques that require no washing-off has been a longstanding objective.

   Washing is especially expensive and undesirable for wool carpet and work for the International Wool Secretariat, using reactive dyes, water-in-oil emulsion thickeners and reactive cationic polymer produced a joint patent application. H.A. Ali, M.Sc. Thesis 1978.

   Significant increases in reactive dye fixation were obtained by minimum application of alkali solution.

   Dave and Miles JSDC 98 (1982) 340.

6. The screen printing process mechanism has been studied. An early study (M.A. Salam, M.Sc. Thesis 1966) produced a hypothesis that was tested on a model system (Boyacigiller, Ph.D. Thesis 1970).

   The measurements of hydrodynamic pressure developed under the squeegee correlated well with Fuller's fluid bearing pressure theory. Subsequent workers have confirmed our pioneer work.

   The complete mechanism is very complex, however, and I am now examining the importance of fabric capillarity forces. Even in engraved roller printing, capillarity is important (Sheslett, M.Sc. 1981).

   I have written a short monograph on Textile Printing (Merrow, 1971) and have produced, as managing editor, a standard text book for the Society of Dyers and Colourists - Textile Printing (Dyers Company 1981).

7. Recently I have studied the photo-discoloration of the jute fibre. We have shown that this is a free-radical process that can be prevented by reduction of the U.V. absorbing groups and by the application of selected energy-transfer systems.

   A.B.M. Abdullah Ph.D. Thesis 1984; TRY 54 (1984) 415; JTI, in the press.

   The Jute Research Institute of Bangladesh hope to use the findings and I have been appointed a UNIDO expert.

8. We are studying the use of microwave heating for continuous dye fixation (S.A. Chaudhary Ph.D. Thesis 1980) and for cotton cross-linking.

9. Other Studies:

Liquor flow in beam dyeing	- W.H. Younan, M.Sc. 1965
Jig dyeing mechanism	- R.H. Haddard, M.Sc. 1966
	D. Burnham, M.Sc. 1968
Solvent dyeing	- R.C. Sheth, M.Sc. 1969
Cotton mercerisation	- M.L.S. Kashemsanta, M.Sc. 1971
Rate of cotton swelling	- O. Panagliotalides, M.Sc. 1980
Closed-loop control of dyeing	- K. Katharios, M.Sc. 1980

In addition to research publications, I have written reviews of Textile Printing (Rev. Text. Progress 1964; Rev. Progress Col. 4 (1973) and 13 (1983); JSDC 93 (1977) 161; Ciba Geigy Rev. 1974/2 and a chapter (with R.H. Peters) in the Chem. of Synthetic Dyes, Vol VIII (Venkataraman).

I have served on the Colour Index Editorial Board since 1965 and on numerous committees of the Society of Dyers and Colourists. I am a member of the British Standards Textile Council and chairman of two sub-committees (Textile Finishing Machinery, and symbols for Textile Machinery).

(a) Fully refereed scientific journals.

1. Miles and L.N.Owen, Dithiols, parts VIII, IX and X, J. Chem. Soc. 1950, 2934-2946.

2. Miles and L.N.Owen, Dithiols, part XII, A new reaction for the formation of sulphides, J.Chem.Soc. 1952, 817-826.

3. W.McDowell, C.K.Meadley and Miles, Migration during convective drying I - Theoretical, J.Soc.Dyers and Colourists, 82 (1966), 414-416.

4. W.McDowell, C.K.Meadley and Miles, Migration during convective drying II - Experimental, J.Soc.Dyers and Colourists 82 (1966), 447-450.

5. M.S.Aboul-Fetouh and Miles, Migration and diffusion of finishing agents in drying, Text.Res.J., 38 (1968), 176-182.

6. Miles, The Development of Transfer Printing, J.Soc.Dyers and Colourists, 93 (1977), 161-164.

7. C.K.Dave and Miles, Low-pick-up Techniques for Reactive Dye Fixation, J.Soc. Dyers and Colourists, 98 (1982), 340-342.

8. A.B.M.Abdullah and Miles, Photostability of Jute, Text.Res.J., 54 (1984), 415-417.

(b) Conference Paper, selected from submission of abstract.

A. Johnson, K.C.Maheshwari and Miles, The Accessibility of Cotton to Dyes, Inst.Text.France, Sirtec 1969, 557-570.

(c) Invited review papers.

1. Miles, Textile Printing, Rev.Text.Prog. (Text.Inst. and Soc. Dyers and Col) 16 (1964), 294-307.

2. Miles, Textile Printing, Rev. Prog.in Coloration (Soc. Dyers and Col), 4 (1973) 44-51.

3. Miles, Dye Fixation in Steam, Ciba-Geigy Rev. 1974/2, 18-24.

4. W. Clarke and Miles, Synthetic Thickeners for Printing, Rev.Prog.in Coloration (Soc.Dyers and Colourists) 13 (1983), 27-31.

(d) Books

1. J.W.S.Hearle and Miles, The Setting of Fibres and Fabrics (Merrow, 1971). Joint editor and author of one chapter.

2. Miles, Textile Printing (Merrow, 1971). A short monograph.

3. R.H.Peters and Miles, The Chemistry of Synthetic Dyes, Vol.8, chapter 4, ed. Venkataraman, (Academic Press, 1978).

4. Miles, Textile Printing (Dyers Company Pub.Trust, 1981). Editor and author of two chapters (Text-book).

PRONOY K. CHATTERJEE
6 Marcin Court
Spotswood, New Jersey 08884

Tel. No. (Res.) (201) 251-4808

PERSONAL Born October 26, 1936; U.S. Citizen.

ACADEMIC Ph.D. and D.Sc. in Polymer Science, Calcutta University, India; MS in Chemistry, Banaras H. University, India

Post Doctoral Research on Polymer Science - Princeton University, Princeton, New Jersey and USDA Laboratory, New Orleans, Louisiana (1963-66)

Research Publications:	Research Papers:	30 - Polymer & Fibers
	Technical Chapters:	5 - Polymer & Fibers
	Scientific Book:	1 - Absorbency (Elsevier Pub.)
	U.S. Patents:	10 - Modified Fibers
	Editing:	Technical Newsletters

Areas of Technical Expertise: Cellulose Chemistry, Heterogenous Chemical Reactions, Kinetics, Swelling Mechanism, Wood Pulp, Cellulose Degradation, Cellulose Derivatives, Thermal Analysis, Acoustimetry, Polymer Grafting, Polymerization, Synthetic Fibers, Adhesives, Vulcanization of Rubber, Surface Modification, Material Science, Biomaterials, Polymer Characterization, Fluid Flow, Absorbency, Surface Physics, Plasma Polymerization, Hydrophilic Foam, Rheology and Viscoelasticity.

EXPERIENCE

1974-Current **PERSONAL PRODUCTS COMPANY (A Divison of Johnson & Johnson)**
Milltown, New Jersey 08850

Manager, Materials Research Department:

- Responsible for directing Company's long-range technology development related to polymeric materials, from fundamental scientific studies to process engineering work, leading to successful commercialization. It also includes technology transfer.
- Assessment and projection of Company's future technology needs and recommendations to management. Technology forecasting.
- Implementation and coordination of outside research contracts in specific polymer areas.
- Administration of the department including budgeting, , anning, recruiting and implementation of multidisciplinary projects.
- Technical consultation on material development and material sciences to Johnson & Johnson International affiliates.

1966-1974 **Senior Research Chemist:**

As a Senior Scientist in Research, the primary responsibility was to develop new polymeric materials. The work resulted in 10 U.S. patents, 15 publications and the installation of a multimillion dollar polymer manufacturing plant.

1963-1966 **PRINCETON UNIVERSITY, Princeton, New Jersey and SOUTHERN REGIONAL RESEARCH CENTER, USDA, New Orleans, Louisiana**

Post Doctoral Research Associate:

Research on Polymer and Cellulose technology, published in several technical journals.

Other Particulars:

- Awarded NAS Research Fellowship (1963)
- Received P. B. Hofmann Research Scientist Award from Johnson & Johnson (1974)
- Education Service Award from Plastics Institute of America (1975)
- Distinguished Lecturer Award from Johnson & Johnson Polymer Subcommittee (1986)
- Served as editor of technical newsletters
- Chaired International Technical Conferences
- Held offices in professional societies
- Traveled overseas to various countries on business.

REFERENCES Available upon request.

BHUVENESH C. GOSWAMI

PROFESSOR OF TEXTILES

CLEMSON UNIVERSITY, CLEMSON SC

BORN OCTOBER 13, 1937, U.S. CITIZEN

B.S., DELHI UNIVERSITY, 1959

M.S., BOMBAY UNIVERSITY, 1963

PH.D., MANCHESTER UNIVERSITY, 1966

TEACHING

AREAS OF EXPERTISE

Development of fine structure in fibers during melt spinning, spun bonding and melt-blowing.
Fatigue behavior of fibers, yarns and fabrics - failure during processing and use.
Mechanics of Processing - yarns and fabrics (including woven, nonwoven and knitted fabrics)
Structural Mechanics of yarns and fabrics (wovens and nonwovens)
Geotextiles - wovens and nonwovens
Mechanism of sorption of pollutant gasses in textiles.

COURSES TAUGHT

Textile Microscopy - Microscopic techniques applied to the study of textiles (undergraduate and graduate)
Textile Testing and Methods of Research in Textiles - (both undergraduate and graduate courses)
Fabric Structure - Woven fabric structure development

Graduate Level

Textile Processing - Equipment and Mechanics of processing of yarns and fabrics (woven, knitted and nonwoven fabrics), Course offered for textiles and polymer engineering students.
Textile Engineering Mechanics - Structural mechanics of yarns and fabrics - course offered for textile science and polymer engineering students.
Physical Performance Behavior of Textile Structures - End use performance and structure - property relationships in yarns and fabrics.
Fiber Formation - Formation of fibers in wet, dry and melt spinning emphasizing rheology of solutions and melts and fiber structure.

PROFESSIONAL EXPERIENCE

Professor, School of Textiles, Clemson University, 1984-present.
Professor, Department of Textiles and Clothing, University of Tennessee, Knoxville, Tennessee, 1980-1984.
Associate Professor, Department of Textiles and Clothing, University of Tennessee, Knoxville, Tennessee, 1975-1980.
Textile Research Institute, Princeton, New Jersey, 1973-1975.
Visiting Research Fellow, UMIST, Manchester, England, 1972-1973.
Staff Scientist, Textile Research Institute, Princeton, New Jersey, 1969-1972.
Post Doctorate Fellow, The Textile Research Institute, Princeton, New Jersey, 1969.
Visiting Lecturer, Clemson University, Clemson, South Carolina, 1967-1968.
Assistant Manager, Calico Chemicals and Plastics, Bombay, India, 1967.
Senior Research Officer, Shri Ram Institute for Industrial Research, Delhi, India, 1966-1967.
Spinning Supervisor, Arvind Mills, Ltd., 1959-1961.

PROFESSIONAL ASSOCIATIONS AND AFFILIATIONS

The Fiber Society, Inc., Lectureship Program (Member 1979-82) (Chairman, 1982), Governing Council Member, (1982-84), Vice President, (1985). President - 1986.
The Textile Institute, Member U.S. National Advisory Committee; Member Executive Committee, 1980 Annual Conference of the Textile Institute, U.S.A., F.T.I. (1972)
American Society of Mechanical Engineers, Textile Industries Division, Member Executive Committee, 1979-present; Secretary-Treasurer, 1982-83, Vice Chairman 1983-84, Chairman, 1984-1985.
American Association for Textile Technology
The Textile Research Institute, Associate Member
Society of Rehology

OTHER PROFESSIONAL ACTIVITIES

Co-Chairman, "Symposium on Failure in Use of Textile Materials," UMIST, Manchester, England, June, 1973
Charter Member, K.L. Hertel Lectureship Committee, University of Tennessee
Chairman - Symposium on ±Consumer in Textiles and Clothing', University University of Tennessee, Knoxville, (1978)
Awarded National Science Foundation
U.S. - India Exchange of Scientist Fellowship, 1979
Participated in NATO - Advanced Study Institute on Mechanics of Flexible Fiber Assemblies, Killini, Greece, 1979
Gordon Research Conference - Fiber Science - Vice Chariman-1987, Chariman 1988.

HONORS

Commonwealth Scholar - 1963-1966
Government of India Scholar - 1961-1963
Fellow of the Textile Institue - 1972

BOOKS

Textile Yarns: Technology, Structure and Applications; B.C. Goswami, J.G. Martindale and F.L. Scardino - John Wiley Interscience, New York, 1977

Classical Papers on the Structural Mechanics of Yarns, J.W.S Hearle and B.C. Gowami, to be published by the Textile Institute, Manchester, England

Fibers, Yarns and Fabrics: Properties and End-uses; B.C. Goswami, K.E. Duckett, T. Vigo, contracted with Wiley Intersciences; Expected publication date - Summer, 1984

CONSULTING

Have done consultancy work with various textile companies here in the U.S. and abroad.

PUBLICATIONS

Hearle, J.W.S., B.S. Gupta and B.C. Goswami, The Migration of Fibers in Yarns. Part V: The Combination of Mechanisms of Migration, Textile Res. J., 35, 972-978 (1965).

Hearle, J.W.S. and B.C. Goswami, The Migration of Fibers in Yarns. Part VI: The Correlogram Method of Analysis, Textile Res. J., 38, 780-790 (1968).

Hearle, J.W.S. and B.C. Goswami, The Migration of Fibers in Yarns. Part VII: Further Experiments on Continuous Filament Yarns, Textile Res. J., 38, 790-802 (1968).

Hearle, J.W.S. and B.C. Goswami, The Migration of Fibers in Yarns. Part VIII: An Experimental Study on a 3-layer Structure of 19 Filaments, Textile Res. J., 40, 598-607 (1970).

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RESEARCH IN PROGRESS

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The Role of Friction in Determining the Structure of Open-End Spun Yarns, funded by Cotton Quality Laboratory, $12,000.00 for two years.

The Nature and Quality of Bonding in Adhesive and Thermally Bonded Polyester Nonwovens, funded by USDA Textiles and Clothing Laboratory, $11,000.00 for two years.

Tensile and Torsional Fatigue Characteristics of Cotton/Polyester Blend Yarns, jointly with Fiber Research Laboratory.

Mechanism of Sorption-Desorption Phenomenon of Pollutant Gases in Textiles, funded by USDA, $12,000.00, 1981-1983.

Thermal Insulation Behavior of Apparel and Drapery Fabrics, funded by American Society of Heating, Refrigerating, and Air Conditioning Engineerings ($10,000.00); USDA Textiles and Clothing Lab ($12,000.00).

INTERNATIONAL ACTIVITIES

Projects funded through PL 480 - Specail Foreign Currency Funds. USDA

- Mechanism of Formation of Air Textured Yarns, with Professors Sengupta and Kothari of Indian Institute of Technology, Hauz Khas, New Delhi, India, October 1985 - December 1988.

- Relationship between Fine Structure and Properties of Cotton Fibers, Cotton Technological Research Laboratories, Indian Agricultural Research, Matunga, Bombay, India, October 1986-September 1989.

APPENDIX 2

AGREEMENT BETWEEN IJIRA AND MILLS

for

PILOT PLANTS

AGREEMENT BETWEEN IJIRA AND MILLS REGARDING PILOT PLANTS

In order to make the IJIRA/UNIDO/UNDP project as effective as possible it has been agreed that the Pilot Plants which are to be an integral part of the project should be installed in selected jute mills . This will give , as far as possible , an industrial environment for the plant and the staff who are assigned to it . Additionally , it is hoped , that it will make the transfer of technology to full-scale use simpler . While the essence of this agreement is co-operation and mutual assistance between the mill and the project it would seem to be of advantage to all concerned to have a written statement governing the conditions under which the pilot plants are installed at the mills .

1. As part of the IJIRA/UNIDO/UNDP Project DP/IND/86/037 the following items of equipment will be installed at _____

_____

2. The cost of erection and commissioning will be borne by the project .
3. This equipment is provided from UNDP/UNIDO funds and remains the property of UNDP/UNIDO until the project is officially ended . At that time the equipment reverts to the Government of India who will determine its future .
4. The equipment is under the control of the National Project Director of the project and it

... continued to page - 2

shall be operated , according to the programme laid down by him . The repairs and maintenance of the equipment shall be the responsibility of the project .

5. An appropriate number of the project staff will be assigned to the pilot plant for operational purposes and a senior member of this staff shall be in charge of the day-to-day operation and maintenance of the plant .

6. The mill provide a suitable site and floor-space (at the mill's cost) for the equipment , prepared to the satisfaction of the National Project Director and his staff . In addition , all necessary mill staff and services shall be provided at the mill's expenses .

7. The mill shall provide , free of cost , to the project , pre- and post-operations and materials , services etc normally forming part of jute mill operations . Special materials eg. non-jute fibres , would be chargeable to the project .

8. With the agreement of the National Project Director the mill may use the pilot plant for their own materials and products provided such use is within the scope of the project and any information about its operation and samples of its products are made freely available to the project . The Mill Manager-in-charge will be expected to co-operate fully with the project staff and vice versa .

9. The plant shall be open for inspection by any member of the industry subject to prior approval of the National Project Director and the Mill Manager-

... continued to pg-3

in-charge . Such visits shall be made only between 0900 hours and 1800 hours , Monday to Friday .

10. Where project staff must stay overnight at the mill , the mill will provide suitable accomodation for them without charge .

11. In consultation with the National Project Director , the jute mill operating the specific pilot plant should agree to provide samples/services , free of all costs to other Member mills of IJIRA as well as to the project itself .

Signed - ----------

Date - ------

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APPENDIX 3

REPORT ON VISITS TO UK AND GERMANY

Introduction

One of the activities in the project is to develop an automated line for sewing jute sacks and bags. No such equipment exists at the moment and two visits were made to companies with whom IJIRA had previously been in contact about this matter in order to make an appraisal of their present equipment and their ability to make such an automatic machine.

The visits were made with Mr. S. Palit, Divisional Head, Mechanical Processing, IJIRA.

Detail of the visits

Samco-Strong Ltd
PO Box 129
Ross Walk
Leicester LE4 5BY
ENGLAND

1 October 1987

Mr. Peter N.E. Wright, Export Sales Manager.

This company makes machines for cutting textiles, cardboard, plastics, leather and similar laminar materials. Their Model Samco 35 1505 was demonstrated cutting up to 12 layers of B Twill fabric at a time. With an accuracy of plus or minus 1 mm, at a speed of about 20 cuts per minute. This is about 10 times current cutting speeds with rotary guillotines. The accuracy of cut is much better too and would lead to significant material savings. One machine is to go to an Indian mill in November for trial.

As a high speed cutting system it seems to offer substantial savings but it could not be integrated into an automatic cutting/sewing line and so no further action should be taken other than to file their technical literature.

Union Special GmbH
Schwabstrasse 33
Stuttgart
W. Germany

7 + 8 October 1987

Herr G. Haisch, Technical Services Manager

with

Carl Schmale + Co GmbH
Postfach 1341
D-4434 Ochtrup
W. Germany

Herr Carl Schmale, Director

Union Special is well known to the industry through their sewing machines for bag manufacture. They have already supplied sewing/hemming units to Schmale + Co for automatic bag-making for polypropylene, paper, etc.

Prolonged discussions took place from which the conclusions were

- it is unrealistic to try to produce a line which would suit all types of sack and bag and handle hessian as well as sacking fabric. Since 80% of all bags are found in A,B,C, twills and DW bagging, the line should handle only these products.
- rather than try to produce a complete line it is better to tackle the project in two parts, the first to make an automatic cutting and hemming unit, then later to add an automatic sewing unit.
- Schmale would prepare costings etc for a cut and hem unit using data to be confirmed by Mr. Palit and send them to IJIRA, if possible by mid-November.

R.R. Atkinson, CTA
10 October 1987

APPENIX 4

SUB-CONTRACT TERMS OF REFERENCE

SUB-CONTRACT FOR FABRIC ENGINEERING AND JUTE BLENDS

(a) FABRIC ENGINEERING

The objective of the sub-contract is to produce fabrics which are lighter than those in use at present but which are of equal strength and have an acceptable cover.

The sub-contractor shall

i. use preferably all-jute yarns of normal commercial quality although yarn counts and twists may be non-standard. Other yarns, e.g., polypropylene, may be incorporated in the fabrics under examination.

ii. generate new constructions to reduce the weights of the following products while, at the same time retaining sufficient strength and cover for them to be commercially acceptable. These constructions must be cheaper than those in use now and must have an 80% jute control at least.

	Present weight	Target weight
100 kg sugar bag	1190 g	as light as possible consistent with costs
100 kg grain bag	1020	
Carpet backing cloth	188 g/m^2	
Cotton bale cover	3700	

iii. optimise the design, manufacture and economics of 50 kg grain bags and 30 kg rice bags

iv. carry out such tests necessary to evaluate these products and to advice on appropriate field trials.

v. prepare a product profile and specification for each product.

vi. assist the project staff to implement these new products in the industry by means of personal contact, seminars, reports and any other appropriate manner. In addition, the sub-contractor shall co-operate with the Research Association's Marketing Unit so that commercial exploitation of these new products may be implemented.

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vii. present a report on the sub-contract (5 copies) within 4 weeks of its termination.

Training

The sub-contractor shall accept for training in fabric engineering one project staff member for a period of three months.

Technology Transfer

The sub-contractor shall provide one Expert who will visit India for two three-month periods to assist the staff of the Research Association to produce bulk samples of these new products and to introduce them to the industry by means of personal visits, seminars and other appropriate avenues.

(b) SUB-CONTRACT FOR JUTE BLENDS

1. The objective of the sub-contract is to assist the Indian Jute Industries Research Association in the application of fibre blending technology so as to develop products which have a higher value and which would allow jute to enter new markets.

2. The sub-contractor shall

   i. review the work already done by the Research Association in this field and select the products most likely to have success in this area.

   ii. generate methods for blending jute and other fibres/and develop new and improved products therefrom. Such methods will include appropriate bleaching and dyeing techniques.

   iii. test and evaluate these products and suggest appropriate field trial methods.

   iv. prepare a full product profile for the manufacture and specifications of these products.

   v. assist in market promotional activities for these products

   vi. give technical guidance on the selection of machinery for blending.

   The duration of the sub-contract will be 36 months, to start in 1988. A report (5 copies) shall be submitted within 4 weeks of the end of the contract.

Training

The sub-contractor shall accept two trainees for a period of three months to be up-dated in their knowledge of blending and product assessment.

Technology transfer

To assist the project staff to implement further blending work at the Research Association and at the pilot plants one Expert shall visit India for two three-month periods to strengthen the project's activities. Personal contacts with research and mill personnel will be made along with participation in seminars, demonstrations etc. in order to ensure that blending technology is transferred to the industry. The Expert will be expected to co-operate with the Marketing Unit in market promotional activities for blended jute products.

Jute as a geo-textile

Terms of reference

BACKGROUND

For many years there have been difficulties in the commercial exploitation of new fabrics developed by the Indian Jute Industries' Research Association (IJIRA). Among other things, part of this has been due to incomplete knowledge of the end-uses requirements. One such development is the use of jute as a geo-textile material. Although not a new use for jute, the present fabric could be improved and others developed if IJIRA had a better understanding of the civil engineering industry's requirements.

To this end, a civil engineer will be recruited on a short-term basis.

The following are the terms of reference :

1. The consultant will fulfil the qualifications and general conditions shown in the attached job description.

2. Initiate technical discussions with civil engineers in Government and industry to study the particular difficulties experienced in erosion control of cut slopes in India.

3. Following such discussions, a work-plan will be presented to IJIRA showing how appropriate fabrics could be developed so as to expand the market for jute.

4. A member of IJIRA 's staff will be delegated to work with the engineer and to render him assistance by providing the necessary textile expertise.

5. A report (5 copies) will be submitted within two weeks of the conclusion of field work.

JOB DESCRIPTION (11-16)

POST TITLE	:	Civil Engineer
DURATION	:	14 days, including travel
DATE REQUIRED	:	December, 1987
DUTY STATION	:	Calcutta with travel within India.
PURPOSE OF PROJECT	:	To strengthen the capability of the Indian Jute Industries' Research Association to assist the industry in developing jute as a geo-textile material.
DUTIES	:	The engineer shall - hold meetings with civil engineer, specifiers, contractors etc. in the Government and private sectors to identify the problems associated with cut slopes in India and their alleviation by means of jute geo-textiles. Such meetings will be arranged by the consultant with the help of IJIRA. - in the light of these discussions he will advise IJIRA, in broad terms, on the most suitable way of developing appropriate materials and introducing them to the market. - prepare a proposal for a programme of development work in India.
QUALIFICATION	:	Professional qualification in civil engineering; extensive experience in technology transfer ability to conduct meetings/ seminars etc. at the highest levels of Government and industry.
LANGUAGE	:	English

SUB-CONTRACT - JUTE/RESIN COMPOSITES

TERMS OF REFERENCE

The objective of the sub-contract is to assist the Indian Jute Industries Research Association to

- develop treated jute intermediate products of suitable form for plastic reinforcement
- develop moulding techniques suited to jute
- develop jute-based rigid packaging using plastic technologies

The contract is expected to begin in the first quarter of 1988 and to last 24 months.

The sub-contractor shall

1. Generate basic methods for preparing jute intermediates by chemical and/or physical means and suggest forms of jute intermediates which would be best suited to mouldings of various sorts.
2. Formulate design and moulding techniques for jute reinforced plastics.
3. Generate designs and moulding methods for rigid containers such as tea-chests, boxes, bins, etc which can be used in India in the first instance.
4. Carry out all tests necessary to evaluate such products and advise on appropriate field trials.
5. Prepare technical and commercial information which will help to establish viable markets for these products.
6. Give a report (5 copies) on the sub-contract within 4 weeks of temination of work.

Training and technology transfer:

The sub-contractor shall accept a trainee under the UN Fellowship Scheme for a period of 6 months for practical and theoretical training. In addition the sub-contractor shall provide one Expert who will visit IJIRA towards the end of the contract to assist with technology transfer under local conditions.