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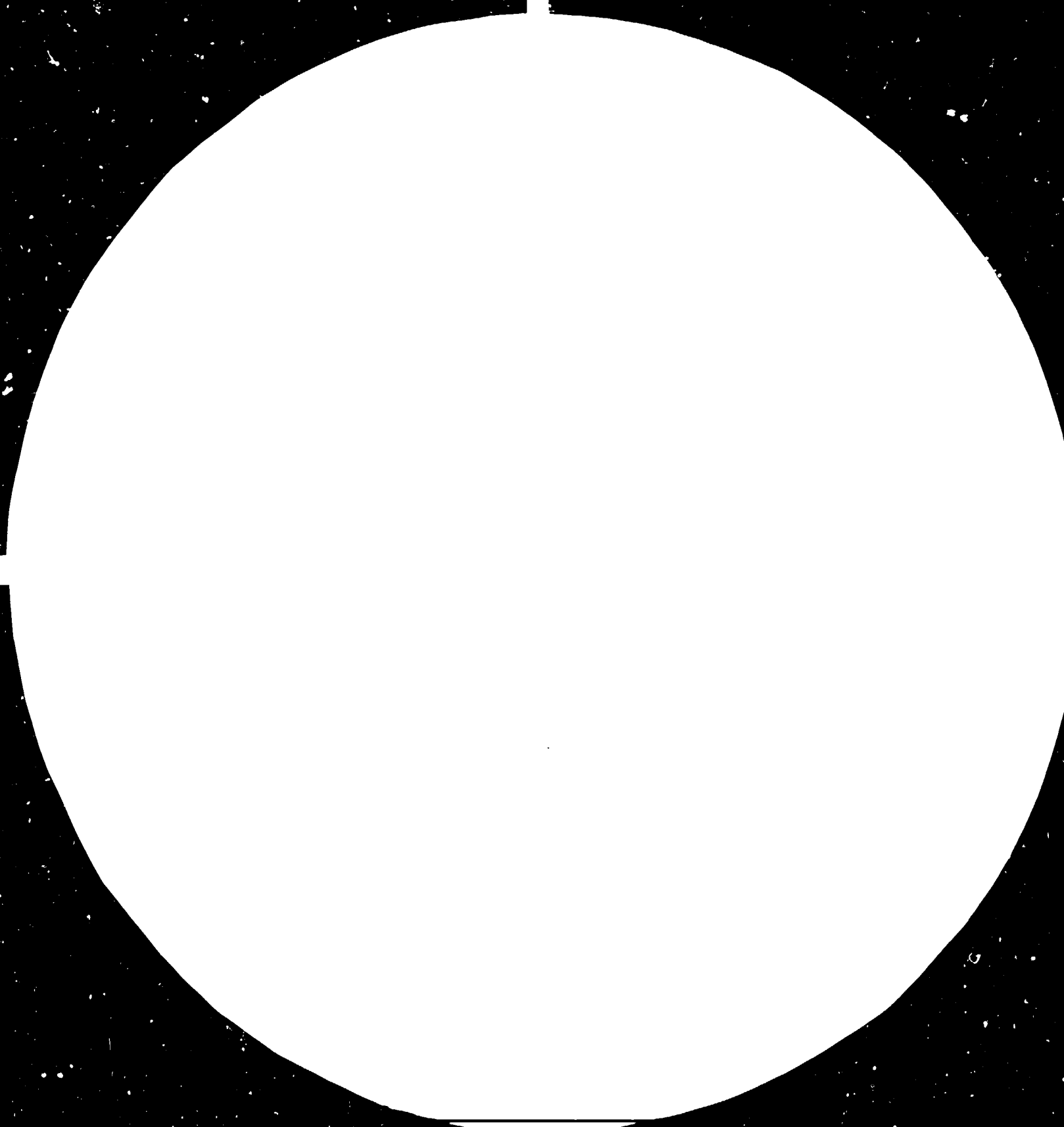

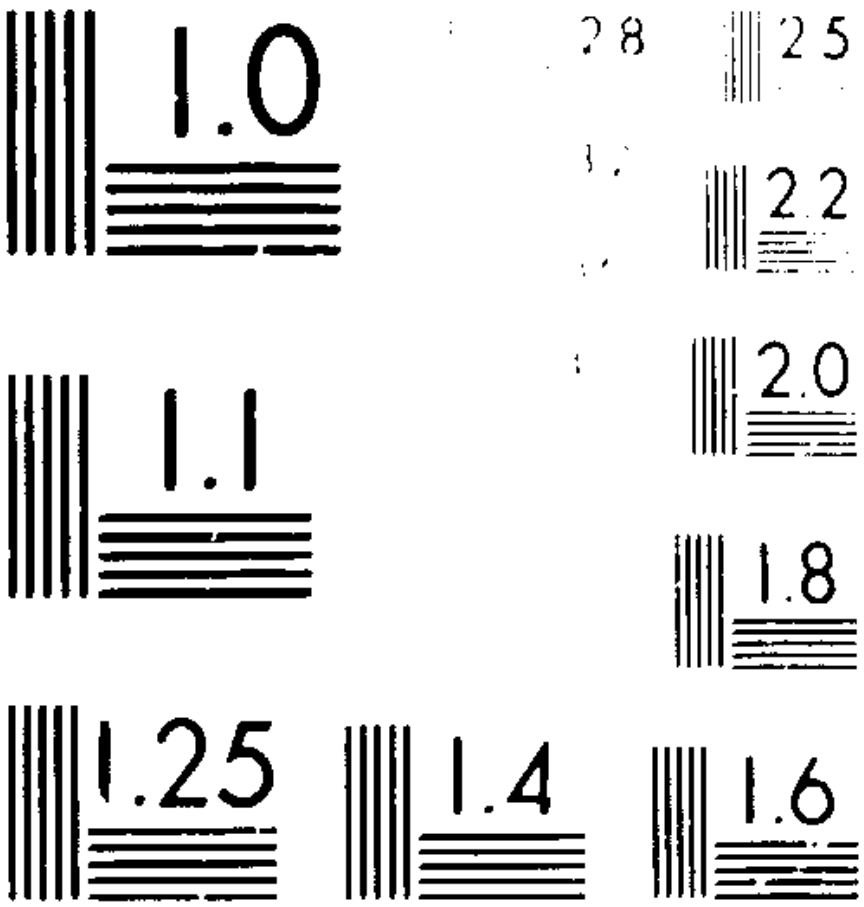
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JUTE PRODUCTS RESEARCH

DP/BGD/75/013

BANGLADESH.

Technical report: Chemical Finishing of Jute and Jute Products*

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

Based on the work of Danuta ZYZKA
Jute Consultant on Dyeing and Finishing of Jute and Jute Products

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United Nations Industrial Development Organization
Vienna

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Project Assistance to the Bangladesh Jute Research Institute (Technology)

BGD/75/013/11-52

Chemical Finishing of Jute and Jute Products

Abstract

This Technical Report is based on the one-month work of the expert in chemical finishing of jute and jute products in the Bangladesh Jute Research Institute (Technology) at Dhaka from 8 November 1982 - 7 December 1982.

The expert has evaluated the activities of the Institute's chemical laboratories and Pilot Plant facilities for the year 1982 and worked with the counterpart on improving and developing processes for chemical pre-treatment, bleaching, dyeing, printing and finishing of jute and jute products.

The Report contains expert's findings and recommendations to the Bangladesh Jute Research Institute (Technology).

The suggestions related to the technological research programme for 1983 in the field of chemical finishing of jute products are enclosed.

Explanatory Notes

BJRI	Bangladesh Jute Research Institute
BJRI (Tech)	Bangladesh Jute Research Institute (Technology)
UNIDO	United Nations Industrial Development Organization
BJMC	Bangladesh Jute Mills Corporation
DF	Dyeing and Finishing Department
TC	Technical Chemistry Department
C	Chemistry Department
B	Biochemistry Department
P	Physics Department
PP	Pilot Plant Department
T	Testing Department

1. Introduction

This project at the Bangladesh Jute Research Institute (Technology), which comes within the United Nations Development Programme for Bangladesh, has the aim of providing assistance to develop the capability of BJRI (Tech) for technological research and development work. The expert's part of the project is in in the field of chemical pretreatment, bleaching, dyeing, printing and finishing of jute and jute products.

Jute is still the country's most important export commodity and also the raw material for the country's most important industry. It is an admitted fact that jute is the mainstay of Bangladesh economy.

The jute and textile mills were nationalised immediately after the independence of the country in 1972. In 1982 the government has decided in principle to return some jute and the textile mills to the private sector.

In view of the increasing competition from synthetics the existence of the jute industry will depend on the increase of its productivity and the development, through research, of better products and new end-users.

The chemical finishing of jute goods based on the latest technologies, is a valuable factor in the improvement of jute yarns and fabrics for both the local and the international market.

This Report should be regarded in conjunction with the First Technical Report on Chemical Finishing of Jute and Jute Products in BJRI (Tech), dated February 1982.

2. Findings related to the Chemical Finishing of Textiles in BJRI (Tech) in 1982

2.1 Laboratory and Trial Production Facilities

According to the recommendations involved in the previous Expert's Technical Report (dated Fabruary 1982) among others a rolling device

for special kinds of desizing, dyeing (Pad-Roll method) and resin finishing process should be designed and constructed in Dacca. A hand-operated device has been procured by the Dyeing and Finishing Department which will be made mechanically operated in due course. The laboratory apparatus like steamer that has been ordered for the DF department is expected to be delivered and installed at the early part of January 1983. The requisition for the purchase of the mill-scale equipment like calender and mercerizing machine has been forwarded by the Project Administrator to UNIDO, Vienna for procurement. The machines are not likely to be delivered and installed before the middle part of 1983.

At present a decision to procure and install shearing - singeing - and flat screen printing - machines has been postponed. The introduction of a screen printing machine could extend the range of new jute products on a large scale. The multicoloured fashionably designed printed fabrics could have a great meaning for the improvement of market potential of jute products. During Expert's stay at Dacca a special table app 50 m long for hand operated flat screen printing has been ordered by PP Department. This can extend the BJRI (Tech) printing facilities but to a limited extent.

Dyestuffs and Chemical Agents

The supply of selected dyestuffs, auxileries and chemicals, necessary for new technologies, has been started, but rather on a small scale. Generally these are to be imported from other developed countries.

The research work in the field of important finishing agents like resin precondensates based on locally available raw materials in going on successfully in the Chemistry Department.

Library

In 1982 the very important books for the DF (Dyeing and Finishing) Department have been procured through the United Nations Technical Assistance. They are:-

- Colour Index - Third Edition - in 7 volumes - published by the Society of Dyers and Colourists in 1982.
- Standard Methods for the Determination of the Colour Fastness of Textiles and Leather - Fourth Edition including September 1981 Supplement, published by the Society of Dyers and Colourists.

A few books concerned with textile chemistry have also been procured by the BJRI Central Library. Subscriptions for following textile journals for the year 1982 have been taken out:

- World Textile Abstracts
- Textile Asia
- Journal of Textile Institute
- The Textile Institute and Industry
- Textile Progress
- Textile World
- Journal of the Society of Dyers and Colourists
- Nature
- Textile Research Journal
- Melliand Textilberichte (english edition)
- Journal of Applied Polymer Science
- Textile Technology Digest
- Jute Bulletin (Jute Development Journal)

Unfortunately the journals do not come regularly. For instance the BJRI Library received in 1982 two complete sets of World Textile Abstracts for the year 1977 and 1978 only.

2.2 Activities in the field of chemical pretreatment, bleaching, dyeing, printing and finishing

Comprehensive Survey

based on the Half-Yearly Technical Report of BJRI (Tech) for the year 1982 and Expert's direct observations and discussions with all people concerned.

Chemical Pretreatment

In the Annual Work Programme for 1982 one project concerned exclusively

with the chemical pretreatment like "Mercerization of jute materials" (TC-19) was included. The work that has been reported in the Half-Yearly Technical Reports, relates only to the generally well-known effect of caustic soda treatment but not to other alkalis.

There is a mention of liquid ammonia application but no detail is available. It would be advisable to collect all details with liquid ammonia treatments for evaluation. The experimental work should be enlarged by studying other alkalis like e.g. potassium hydroxide.

Some details concerned with "cold" and "hot" (50-70°C) woolenisation i.e. mercerisation in 15-20% concentration of NaOH, have been presented in project DF-17 p.b. "To establish dyeing methods for modified jute fabrics including union and blended fabric". But actually the work under this project has not been concerned with dyeing but only with woollenisation.

The jute fabric became light brown in colour due to swelling by hot NaOH rather than by cold. The consumption of NaOH was higher in cold mercerisation as in hot process. Hence it seems to be possible to reduce the cost of woolenisation by means of hot process but the method requires more experimental details.

In the Pilot Plant Department a significant quantity of Novocel yarn (woolenised) for private organisations has been handled.

Bleaching

In the project DF-15 "Bleaching of jute materials" some experimental results have been reported in the 1982 Half-Yearly Progress Report on the "Pad-Roll" method with hydrogen peroxide as a bleaching agent with various rather high concentrations of H_2O_2 and sodium silicate (stabiliser). After this Report some experimental work on various lower concentration of H_2O_2 have been started but only at the room temperature. It would be advisable to study the effect of higher temperature too. For the fulfilment of experiments on a mill scale a mechanised rolling-device is needed.

Printing

The project DF-16 "printing of jute fabrics" consists of: (a) To develop printing technic/methods (b) To study the physico-chemical aspects of printing. The printing experiments have been done on raw, scoured and desized or bleached, mercerised or unmercerised jute fabric. Two types of printing have been done by using reactive dyestuffs in one set and pigment dyestuffs in other set. Hand operated screen printing device and some new, previously prepared screen patterns have been used.

The research work on these two types of printing technics has not been completed. Especially the fastness properties of the printed fabrics are yet to be studied. Also the range of dyestuffs should be enlarged and more experiments should be carried out.

Dyeing

Comparetively to other finishing problems much more research has been done in 1982 in the field of dyeing. In the project DF-17 "Dyeing of jute materials" three classes of dyestuffs have been studied i.e. reactive, basic and azoic dyes.

Additionally in the PP Department some experimental work has been done with sulphur dystuffs for new end uses of jute, such as fabrics for jeans-like trousers and any other garments.

In studies concerned with reactive dyestuffs three methods like "Pad-Batch", "Pad-Jig" and "Pad-Heat" have been compared. A "Pad-Heat" method of dyeing jute cotton union fabric with selected procion dyestuff has been developed. Shade and tone penetration, uniformity were found very good in "Pad-Heat" method in comparison with "Pad-Batch" and "Pad-Jig" method. Dyeing process by "Pad-Heat" method by variation of fixation time and temperature will be continued.

It would be advisable to compare also the "Pad-Roll" method according to recipe No. 7 in the First Technical Report on Finishing in February 1982. For that purpose a mechanised rolling device in a chamber is needed, which would enable the experiments to be carried out at higher temperature. Such chamber can be designed and constructed in Dhaka.

Also the number of dyestuffs to be used should be enlarged, comprising the "cold" as well as "hot" reactive dyes.

In studies concerned with basic dyes it was observed, that rubbing fastness of methylene blue on jute fabrics is very good, but washing fastness-poor. Although basic dyestuffs have no appreciable affinity for cellulose they have a very great affinity for lignin and are retained very well by bleached ones. Improvement of the wash fastness is to be attained. The very important factor, especially for basic dyes, the fastness to light should be checked. A good selection of dyes is required.

Also a good selection of azoic combination is necessary. Actually some new bases have been delivered to the DF Department like e.g. Scarlet RC Base, Yellow and Orange GC bases, Brenthol Fast Garnet GBC base and others. The previous experiments have been made by means of two very old bases and one Naphtol AS. The good fastness to rubbing, and light fastness by measurement of reflectance values, has been established. The work will continue based on new dyeing components.

In the Pilot Plant Department in all, nearly 2800 yards of all-jute and jute/cotton union fabric has been bleached and dyed, of which about 500 yards was supplied by private organizations.

Finishing

In order to establish chemical methods for prevention of yellowing of natural and bleached jute (Project TC-18) the following research work plan on jute fabric has been taken up.-

- To carry out benzoylation by the treatment with benzoyl chloride in presence of pyridine in different conditions.
- To see the action of epichlorohydrin vapour on alkali treated (using different percentage) jute materials.
- To assess photo-fading of shades of dyed/printed materials.

Results in reflectance values corresponding to different concentrations of chemicals and time of treatment were observed before and after 90 hours exposure on sun light.

The present experimental work is to be continued further to find out suitable proportions and conditions of all the reactants because till now no considerable improvement in yellowing in comparison to the untreated sample has been obtained.

With the application of epichlorohydrin vapour the next project TC-21 "To improve the resiliency of jute carpet by chemical means" is connected.

Some experiments have been made to improve the crease recovery of scoured and bleached jute fabrics by impregnation with sodium hydroxide, followed by exposure to epichlorohydrin vapour. The epichlorohydrin improves the resilience, and the purpose of the alkali treatment is to swell the fibres and so make easier penetration of the vapour into the fibre.

However, some encouraging details have been submitted in connection with the alkali treatment with epichlorohydrin vapour exposure time fixed at 10 minutes only. It would be advisable to extend the experiment further not only within higher concentration and longer time of alkali treatment but also to study the influence of time of the epichlorohydrin vapour treatment on the crease-recovery of jute fabrics.

The important project C-22 to develop a resin finish for jute fabrics is going on according to plan. In view to improving the serviceability characters of the jute products as well as diversifying its uses the research studies have been undertaken for chemical modification of jute fabric by the methods of crosslinking. The outline of the work is as follows:-

- Synthesis of suitable urea-formaldahyde and melamine-formaldehyde precondensates or their equivalent compounds capable of cross - linking in the cellulose chains of the jute fabrics.
- Investigation on the interactions between the jute fabrics and the synthesised precondensates.
- Studies on the textile parameters of the above modified jute fabrics.

With the problem of end-finishing using resin precondensates, urea and some different phosphates the project TC-23 (a) "To develop process for fire-retardant finishing for jute by chemical means" is combined. A research work has been undertaken and is going on well to find out suitably applicable durable fire-retardant process with optimum conditions of application with minimum loss of tensile strength. Actually good flameproofing results have been achieved but further experiments are necessary to reduce the loss of tensile strength.

In sub-project TC-23(b) to develop fire retardant process for jute by physical barrier method by application of ammonium dihydrogen phosphate, ammonium chloride and borax the proper results have not yet been achieved. It would be advisable to increase the amounts of chemicals to be used and to determine the flame resistance, especially the self-extinguing effect, by a horizontal method of testing.

In the experiments of project B-24 "To develop rot-proofing process for jute" copper sulphate, sodium carbonate and a binding material have been used. It has been concluded that jute materials treated with less than 2.5% copper sulphate along with other reagents will never be rot proofed adequately.

In the further experiments the locally available gum of tamarin seed as a binder will be used. The determination of rot proofing on jute materials should be also carried out during a longer period (28 days of exposure to soil instead of 12 days) according to European Standards.

No progress has been done till now in Project TC-26 "To use jute as reinforced plastic materials". As the project is at the beginning the work should start with an exhaustive literature survey followed by the recognition of local facilities.

2.3 Co-ordination and Co-operation between BJRI (Tech) and BJMC/Private Jute Industries

In 1982 the Bangladesh Jute Research Institute (Technology) has conducted a Three-Month Training Course on "Jute Technology" for twenty three technical personnel (supervisors) from the Jute Industry Sector. One

of the subjects of the Training Course was "Chemical Pretreatment, Bleaching Dyeing and Finishing".

The representatives of the BJRI (Tech) and the Bangladesh Jute Mills Corporation have been having regular meetings at two months interval, to discuss how effectively find solutions to the problems encountered by the industry including the finishing problems.

Some private factories have been strengthening the linkages with BJRI (Tech in the field of chemical finishing of jute products. They are:-

1. Ajanta Printing and Dyeing Works, Dhaka
2. M/S United Enterprises, Dhaka
3. Village Education Resource Centre, Savar, Dhaka
4. Bangladesh Small and Cottage Industries Corporation, Dhaka
5. Modern Screen Printing and Dyeing Works, Dhaka

A significant quantity of white to cream and also dyed, woolenised and unwoollenised all jute/jute cotton union good quality fabrics have been produced in Pilot Plant Department of BJRI (Tech) as per requirement of above mentioned private organisations.

3. Expert's activities

According to the UNIDO job description DP/BGD/75/013/11-52/31.7.B consultant in chemical finishing of jute and jute products, attached to the Bangladesh Jute Research Institute (Technology) at Dhaka was expected to work with the counterpart on the improvement and development of processes of bleaching, dyeing, printing and finishing of jute and jute products.

3.1 Evaluation of the Technological Research Work for 1982 in the field of chemical finishing of jute and jute products

Special emphasis has been given to the Dyeing and Finishing, Technical Chemistry, Chemistry and Pilot Plant Department regarding their range of research work and their facilities. Relevant findings are submitted in this Report in detail in Chapter 2.

On the whole the progress on research in the field of chemical finishing of jute and jute products is going on and moving towards right direction.

In current year much progress has been made in dyeing and finishing (flame proofing, rot proofing, crease-resistant finish) but rather less in printing. Actually a laboratory trial on the interesting Pad-Roll method for bleaching is being undertaken.

In the field of chemical pretreatment the processing method for "hot" instead of "cold" woollenisation i.e. mercerisation in 15-20% concentration of NaOH, has been proved.

In the field of dyeing the range of selected dyestuffs has been enlarged and such classes of dyes as azoic, basic and sulphur dyes were involved as well as the direct and reactive dyes.

The research work on finishing like durable flame proofing, rot proofing, crease resistance and develop/ment of resin is going on according to plan.

3.2 Consultations

Many direct consultations and advices concerned with all fields of chemical finishing of jute goods were given by the expert to the research workers in BJRI (Tech). Special care had been given to the following subjects:-

- Bleaching according to Pad-Roll method
- Chemical methods for prevention of yellowing of natural and bleached jute.
- Dyeing with azoic diazo components
- Printing technics and the preparation of the screen patterns
- Synthesis of the urea-and melamine-formaldelyde precondensates
- Crease-resistant resin finish and the mechanism of crosslinking
- Determination of the flame-and rot proofing effects on jute fabrics
- Standard methods for the determination of the colour fastness of textiles.

3.3 Suggestions related to the Technological Research Programme of BJRI (Tech) for the year 1983 in the field of chemical pretreatment, bleaching, printing, dyeing and end-finishing.

However, at present the progress on research in chemical finishing of jute goods is going on towards right direction, some modifications in the Annual Work Programme for 1983 are required. In Expert's opinion following objectives and projects should be included into the above-mentioned programme:-

Re: Objective No.6: To develop methods of bleaching, dyeing and printing

DF Bleaching of jute materials

(no change in comparison with the programme of 1982)

a. To develop methods of bleaching of jute products

b. To study the economy, efficiency and qualities of products

c. To measure the whiteness/brightness of the products

DF Printing of jute fabrics

(change in p.a. instead of "To develop printing technic methods"and b. "To study the physico-chemical aspects of printing")

Proposals:

a. To study the printing properties of different classes of dy to establish standard printing methods for jute fabrics

b. To measure fastness properties (washing and rubbing)

c. To measure colour changes due to light.

DF Dyeing of jute materials

(change in p.c. "To study the chemistry of dyeing" - to be omitted, in p.d. " To measure fastness properties to washing and rubbing" and p.e. " To measure colour changes due to light").

Proposals:

a. To study the dyeing properties of different classes of dyes and to establish standard dyeing methods for jute materials

b. To establish dyeing methods for modified jute fabrics including union and blended fabrics

c. To measure fastness properties to washing, dry cleaning (for selected goods only) and rubbing.

d. To measure colour changes due to light and prepare suggestions related to the determination of dye fastness to light on jute according to the international scale.

Re: Objective No.7 : To change the chemical and physical characteristics of jute by chemical means.

TC Study and prevention of photo-chemical changes in jute.

(no change , eventually p.c. should be the first)

a. To establish chemical methods for prevention of yellowing of natural and bleached jute

b. To establish chemical methods to prevent loss in strength by light

c. Structural studies on chemistry of lignin

d. To measure whiteness/brightness.

TC Mercerisation of jute materials

(no change except the addition ("except NaOH") in p.a.

a. To examine the effect on jute materials by treatment of alkali/ liquid ammonia (except NaOH)

b. To measure physical characteristic of the mercerised jute

c. To measure thermal properties of mercerised jute and jute products.

Re: Objective No.3 : To improve the market potential of jute products (no change in the field of chemical finishing)

TC To improve resiliency of jute goods

a. To improve resiliency by chemical means.

C To develop suitable resin finish for jute materials

a. Development of suitable resin precondensates for jute materials and evaluation of the products.

TC To develop fire retardant process for jute materials

a. By chemical means

b. By physical barrier methods

TC To use jute as reinforced plastic materials

B To develop rot proofing process for jute materials

Re: Objective No. 9 : Trial production and technical services

PP Production of different new jute products for test marketing
(no change in the field of chemical finishing)

The chemical processing including dyeing and finishing of jute products as well as the dyeability tests and analysis of dyes are involved.

Re: Objective No. 10: Miscellaneous

TC The process for production of branding ink is included.
(no change)

4. Conclusion and Recommendations

4.1 Summary

The Bangladesh Jute Research Institute (Technology) at Dhaka acting as the Government Institute, is the principal source of research and development work for the nationalised as well as for the private jute industry. In 1982 the Government has decided in principle to return the jute and the textile mills owned by only Bangladeshis to them.

The BJRI (Tech), which in 1978 received technical assistance from the United Nations Industrial Development Organization/United Nations Development Programme, has now the required basic technical facilities to carry out the research work in the field of chemical finishing of

jute and jute products. The equipment for the chemical technology, especially in the Pilot Plant Department represents international standard. Generally the progress on research in the field of chemical finishing of jute and jute products is going on and moving towards right direction. In the current year much progress has been made in dyeing and finishing (flame proofing, rot proofing, crease-resistant finish) but relatively less in printing.

4.2 Recommendations

Regarding the actual status of BJRI (Tech) in the field of chemical finishing of jute and jute goods in order to achieve the best results in fundamental and applied research work the expert suggests following recommendations:-

Research work organization

1. In respect of greater consolidation of efforts the created teams of research workers from different Departments, groupped according to specified objectives, should have the meetings at least every 1-2 months to discuss the progress and difficulties encountered in the research work.

2. It is necessary to demonstrate the chemical technology processes to the jute industry and to conduct some training courses for the mill personnel on a much larger scale as it is done at present.

3. To carry out the research work more intensively it would be advisable to arrange for some research workers from DF, TC and PP to perform simple tests in other Divisions where such facilities exist.

Research Projects

The same finishing projects, specified in the Work Programme for the year 1982 as the most important for the jute industry remain for the year 1983. They are as follows:-

- To study the dyeing properties of different classes of dyes and to establish standard dyeing methods for jute materials

- To develop printing technic methods
- To establish chemical methods for prevention of yellowing of natural and bleached jute
- To develop suitable resin finish for jute materials by using different monomers
- To develop fire retardant process for jute
- To improve the resiliency of jute materials.

The project "Bleaching of jute materials" may include the Pad-Roll method of bleaching. In the Bangladesh Journal of Jute and Fibre Research the number of publications concerned with chemicals finishing of jute goods should increase in the next few years.

The experimental results presented in the Half-Yearly Technical Reports may not contain so many exhaustive tables. It will be better if the interesting results are produced in graphs.

Equipment

1. A "Rolling-device" necessary for the "Pad-Roll" method concerned with some kinds of desizing, bleaching, dyeing and resin finishing processes should be put into mechanical operation and located in a chamber with heating arrangement.

2. A printing table, approximately 18 feet long, should be located in Pilot Plant Department. Some new, fashionably designed and carefully prepared screen patterns are also necessary.

3. To keep the jute textile production on an international level it is necessary to enlarge the range of applied modern dyestuffs and finishing agents.

4. The subscription of at least few most important journals like Textile World Abstracts and others (specified in the Chapter 2.1) should be renewed for the year 1983 and the next years.

Annex I

Expert's Work Programme from 8 November - 7 December 1982

8	November, 1982	- Departure from Poland entry on duty
9	November, 1982	- Arrival in Dacca
10-14	November, 1982	- Review of the Dyeing and Finishing Department activities
15-21	November, 1982	- Review of the Technical chemistry, Chemistry and Biochemistry Department activities
22-28	November, 1982	- Review of the Pilot Plant Department activities
		- Consultations for BJRI (Tech) staff members in the latest technics of chemical finishing of jute and jute products
		- Work with the counterpart on improving and developing new processes for chemical finishing of jute and jute products
29	November, 1982 - 3 December, 1982	- Preparation of the Final Report
4-5	December, 1982	- Departure from Dacca to Vienna
6-7	December, 1982	- Debriefing in Vienna and completion of assignment