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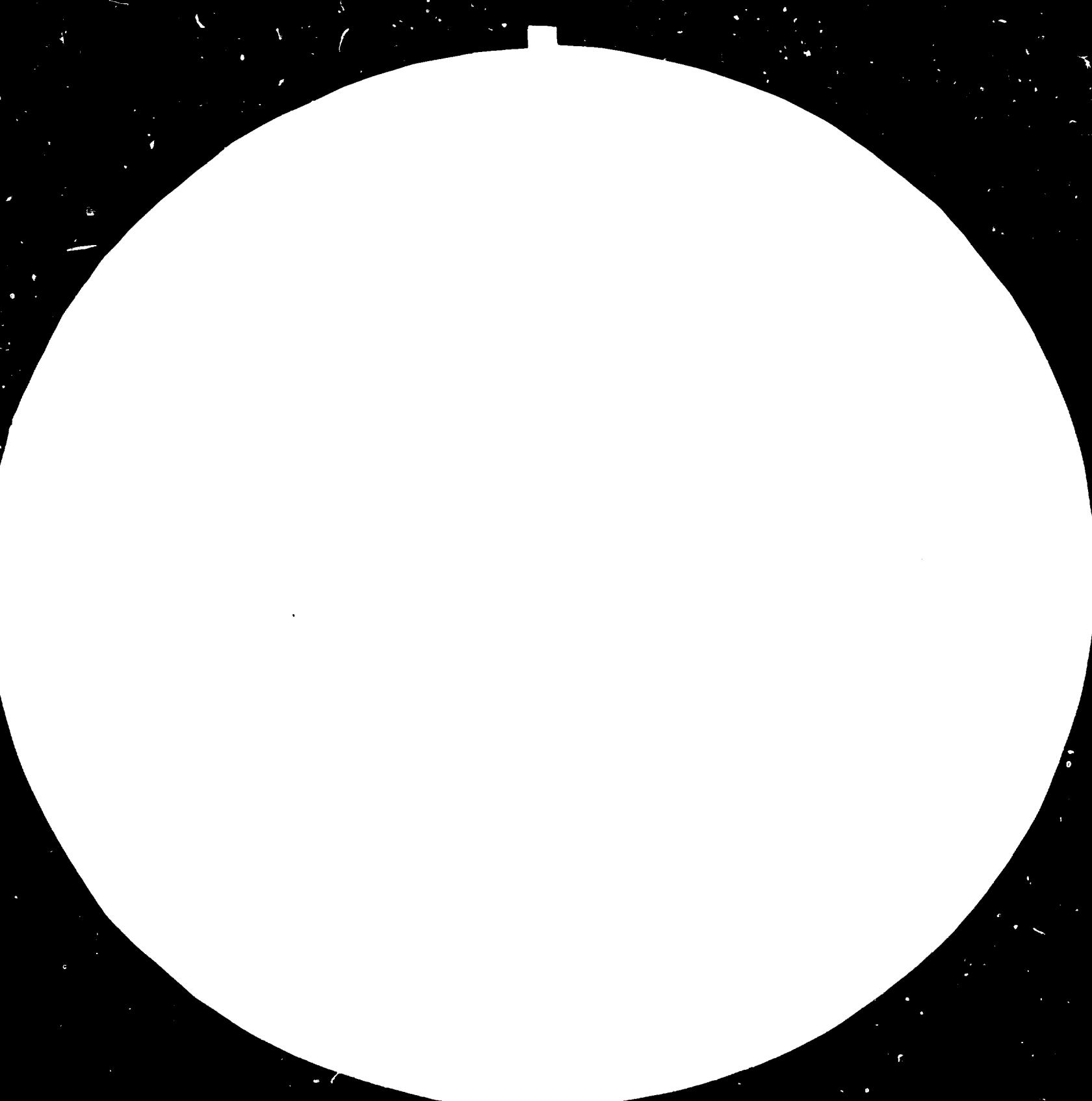
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JUTE PRODUCTS RESEARCH

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

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 three-month work of the expert in chemical finishing of jute and jute products in the Bangladesh Jute Research Institute (Technology) at Dacca from 15 November 1981 - 14 February 1982.

The expert has recognised the organization, equipment and activities of the Institute's chemical laboratories and Pilot Plant facilities, visited Dyeing and Finishing Departments in factories and worked with the counterpart on improving and developing processes for chemical pretreatment, 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).

Suggested new technologies for various products made of jute with frame-recipes in details as well as the technological research programme in the field of bleaching, dyeing, printing and end-finishing are enclosed.

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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
PP	Pilot Plant Department

Summary of Findings and Recommendations

1. Basic items of equipment for research and demonstrations purposes in the field of bleaching, dyeing and finishing of jute goods have been provided. The delivery of two next machineries i.e. a Mercerizing machine and a Calender is expected in the later part of 1982. (Annex II)
2. To complete the Production Trial Facilities and extend the research areas, the installation of a shearing machine, a singeing machine, a flat screen printing machine a rolling device and a steamer are recommended. (Paragraph 2.2.1)
3. Progress has been made in last few years in the chemical pretreatment and bleaching of jute yarns and fabrics, but less in printing and dyeing. Actually some interesting methods of finishing have been tried on a laboratory scale. (Paragraph 2.2.2)
4. In respect of greater consolidation of efforts the teams of research workers should be created, irrespective of the divisional structure of BJRI (Tech), to solve project objectives. Each of specified objectives should be directed by one person, responsible for the results. The form of the utilization of research findings have to be specified in work programmes. (Paragraph 2.1)
5. To have the jute textile production on international standard level, it is necessary to use a wide range of new kinds of dyestuffs and finishing agents. (Paragraph 2.2.2)
6. New finishing technologies for jute products with frame recipes in details have been suggested. They have been selected from the economical and technical point of view. (Annex V)
7. It would be useful to develop a commercial method of production of resin precondensates. (Paragraph 2.2.2)
8. Recommended procedures for various jute products are presented in Annex VI.
9. The list of necessary subscriptions to at least few Journals has been presented. (Paragraph 2.2.1)
10. The cooperation between BJRI (Tech) and the jute industry had been established. There is a need for the research staff to demonstrate the technical feasibility of the manufacture on new or improved jute products to the industry. (Paragraph 2.2.3)

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 in the field of bleaching, dyeing, printing and finishing of jute products.

The first phase in the provision of laboratory and trial production facilities for the chemical technology has been completed with the installation of 8 basic items of equipment for research and demonstration purposes. The next finishing machinery is expected to be installed in the later part of 1982.

The total cost of the installed equipment for the chemical technology is approximately 700,000 US\$.

With regard to the existing facilities in BJRI (Tech) and the importance of jute products for the People's Republic of Bangladesh, the UNIDO's project objective is to improve and develop the chemical pretreatment, bleaching, dyeing, printing and finishing processes for jute products for various new uses of jute. All the processes should be commercially applicable.

Jute is still the country's most important export commodity and also the raw material for the country's most important industry. Since March 1972 the Bangladesh jute industry is completely nationalized.

In view of the increasing competition from synthetics, mainly from polypropylene, 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.

In order to improve jute products and to make them more attractive for the local and international market the expert suggested in this Report new technologies for various jute products. The technologies involved are all the basic fields of chemical finishing.

2. Findings

2.1 Objectives and organization of the Bangladesh Jute Research Institute (Technology)

The Bangladesh Jute Research Institute is the principal source of research and development work for the jute industry. It consists of three wings:

- Seed Production
- Agriculture
- Technology

The Technological Research Wing, which received in 1978 the UNDP technical assistance, has five divisions:

- Chemistry and Biochemistry
- Technology
- Physics and Testing
- Mechanical Processing
- Textile Engineering and Pilot Plant

Each division is divided into 2 - 3 Departments.

The main objective of the Technological Research Wing is to assist the jute industry by:

- undertaking applied and fundamental research
- studying current and long-range problems

- developing processes and equipment
- providing consultancy service
- training mill personnel in various fields
- undertaking quality - control
- providing documentation and information services

To cope with the above-mentioned tasks the annual research programme is being made. Comparing the "Objectives" in last few years the progress in the range of research work and improvement of its organization is evident. Here the great contribution of Dr. H.P. Stout, expert of the United Nations Industrial Development Organization is to be emphasised.

The work programme for the years 1981 and 1982 are ambitious and expanded and considerably appropriate to the needs of the Bangladesh Jute Industry. Also the form of half-yearly reports published in special comprehensive volumes is praiseworthy.

Many Projects are related to one another and good working relationship are especially required between Chemistry, Technology, Testing and Pilot Plant Divisions.

To avoid the multiplication of some research work in respect of greater consolidation of efforts it would be useful in expert's opinion to create a teams (groups) of scientific research workers to resolve concrete problems irrespective of the divisional structure.

Like in many Research Institutes in Europe or United States such teams could operate much more effectively, because the people are personally interested and responsible for the effects.

Some work in this field recently has been done namely the grouping of the work of BJRI (Tech) under specified "Objectives" to obtain a greater consolidation of efforts. It is evident that it is very useful. In

expert's opinion each of specified Objectives should be directed by one person, responsible for the results. It should be a high-level staff member with experience in research, having good influence with working people. In case of his long term absence his representative should be nominated. This could secure the continuity of research work.

For each objective the forms of end-use have to be specified. In most cases it should be the introduction of new technologies into the mill practice.

All research-teams should have the meetings separately for each "Objective" at least every three months to discuss with all concerned persons the progresses and (if any) difficulties in research work in the specified objectives.

2.2 Chemical Finishing of Textiles in BJRI (Tech)

In the Bangladesh Jute Research Institute (Technology) three Departments are directly interested in the chemical finishing of textiles. They are:

- Dyeing and Finishing Department
- Technical Chemistry Department
- Pilot Plant Department

Three others are indirectly (from the technological point of view) involved namely:

- Chemistry Department
- Biochemistry Department
- Testing Department

2.2.1 Laboratory and Production Trial Facilities

Successful product development is strictly combined with laboratory

and pilot plant equipment for chemical technology that is bleaching, dyeing, printing and finishing. Since the inauguration on September 1981, Production Trial Facilities (based in great amount on UNIDO deliveries) became operational, covering the needs of experimental work on a laboratory and Pilot Plant scale in the field of chemical pretreatment, bleaching, dyeing and finishing. The printing only is not included into the range of possibilities. The new installed equipment represents a good world standard. For the implementation, great contribution of UNIDO Project Administrator, Mr. Conrado I. Diala is to be emphasised.

Annex II carries a list of existing Pilot Plant and laboratory machineries from UNDP and own sources. The exploitation of such equipment is demonstrated in Annex III "Dyeing and Finishing Shed Processing Schedule, BJRI (Tech)".

The list of Pilot Plant machineries for fabrics, recommended for next years, is also presented in Annex II. Shearing and Singeing machines are especially important for printed goods, where a smooth surface is desired. The implementation of a screen printing machine could extent the range of new jute products on a big scale. The multicoloured, fashionably designed printed fabrics could have a great meaning for the improvement of market potential of jute products.

As suggested in this report (see Annex IV and V) with new technologies two new items are combined like steamer and a rolling-device. The last one can be designed and constructed in Dacca.

Dyestuffs and Chemical Agents

For new technologies the supplies of selected dyestuffs, auxiliaries and chemicals are necessary. The need for Chemistry Department for extensive research work in the field of resin precondensates - important finishing products, is to be mentioned. The raw material like urea is available

locally. A great deal of chemicals, dyestuffs and auxiliaries are however to be imported from other countries.

The selected groups of dyestuffs and the names of some commercial auxiliaries for new technologies are presented in Annex V.

Library

To carry out the research work in a proper manner a good equipped library is very important. The BJRI (Tech) has a central library, which contains around 1000 books, but relatively small amount of them concern the finishing problems and generally there are rather old publications. Subscriptions of 20 journals have been taken out at different periods, but there are few continuous ones. It should be advisable in expert's opinion to give much effort to the complementation of basic issues such as World Textile Abstracts and Chemical Abstracts.

From the chemical finishing point of view the most interesting journals are:

Journal of the Society of Dyers and Colourists, Textile Technology Digest, Journal of the Applied Polymer Science, American Dyestuff Reporter and Melliand Textilberichte (English edition) . At present all the previous subscriptions were cancelled because of lack of foreign currency. Some modern books concerning chemical finishing of textiles should also be delivered. The appropriate list of required books (prepared by Scientific Officers) has been presented to the Board of Directors, in January 1982.

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

Comprehensive survey:

There is a big variety of processes concerning the chemical finishing of jute textiles. In BJRI (Tech) many of them are more or less involved in the research programmes.

Comparing the results achieved in various fields of finishing in last few years it is evident that much progress has been made especially in the chemical pretreatment and bleaching of jute yarn and jute fabric, but rather less - in printing and dyeing. Actually some interesting methods of finishing have been tried on a laboratory scale.

Pretreatment

In the field of pretreatment the method of alkali treatment by means of cold caustic soda solution at a concentration of about 18% called "woolenisation" has been developed. New jute products with improved quality (better mechanical characteristics and dye absorbency) like Novocel yarn and Novotex fabric are now produced on a commercial scale. The modified yarn may be used as a knitting wool substitute or for making blankets, carpets or union fabrics suitable for trousers, suitings and furnishing materials. The modified fabrics may be used for curtains, wall coverings and furnishing materials and also for some kind of apparel goods.

The research work in the field of alkali pretreatment is going on. A comparison study has been carried out between "cold" at room temperature and "hot" i.e. at 50°C mercerization giving some advantages to the last one, especially in the tensile strength.

An ambitious project to replace conventional pretreatment on jute materials with caustic soda by liquid ammonia like in the most advanced countries in the world is going on in the Technical Chemistry Department. This project has rather an aspect of a fundamental research work. A special equipment is needed to put this technology into the mill practice and there are very little chances to have such expensive equipment in next few years in the Bangladesh Jute Industry. In expert's opinion the research work should be consolidated in the future and focus should be rather on the most economic and industrial applicable processes.

Bleaching

The one step and two step bleaching methods for yarn and fabric has been developed in BJRI (Tech). The application of sodium hypochlorite, hydrogen peroxide, sodium chlorite and potassium permanganate as well as the bleaching with reducing agents like sodium sulphite and sulphur dioxide were tried. It was found that the bleaching action of reducing agents was very poor as regard to jute. The oxidizing agents were only successful. Hence the commercially applicable methods are till now based on the three first agents. These methods are being used on a pilot plant scale.

Dyeing

In this field the achievements in research work need some improvements. The research work on dyeing was carried out with few direct and reactive dyestuffs (Two patents are granted).

Concerning the development of dyeing methods the studies on application of different classes of dyestuffs (direct, reactive, acid, basic and vat) are anticipated. The study on the chemistry of dyeing is also provided.

Within the new technologies especially the "Pad-Jig" and "Pad-Roll" methods for dyeing with reactive dyestuffs should be tried for jute and adjusted to the mill conditions. The development of pigment dyeing for some jute goods is also recommended.

Printing

Substantial progress has not been made in printing except the elaboration of a transfer printing method. (A patent is granted). This is an interesting original method of heat transfer printing on modified jute fabric.

The equipment for printing in the Institute is not adequate to carry on expanded research programme. In the Institute there is only a small hand-operated device for laboratory trials. Regarding the great significance

of printed fabrics in the textile market the investigations in this field should be much more expanded both on a laboratory and pilot plant scale. Especially the pigment printing is recommended for various jute products.

Finishing

In comparison to the dyeing and printing much more progress is done in the field of end-finishing of jute goods. Some kinds of new special finishes are being developed. It has to be emphasised that independently of Dyeing and Finishing, Technical Chemistry and Pilot Plant Departments two others Departments like Chemistry and Biochemistry are deeply engaged in these investigations. For example: the flame proofing methods are investigated in Technology Division by means of ammonium bromide and phosphoric acid and in the Chemistry and Biochemistry Division by means of antimony oxy-chloride. The results achieved in the first method are till now more interesting. It was found that jute fabrics on treating with above-mentioned chemicals under certain conditions can be made flame proofed without much lossing the tensile strength. The disadvantage of this method is lack of permanent effects what means, that the method could be suitable for these fabrics which do not undergo the washing (wall-coverings etc.)

The research work concerning fire retardant finish for jute carpets has been noted by the Bangladesh Jute Mills Corporation as a work of vital importance. Hence the investigations are going on and it seems to be useful to create a team of research workers strictly involved in this problem to consolidate the efforts. For permanent effects some kinds of reactive fire-retardants should be tried, or the addition of melamine resins as well as the use of antimonium and titanium oxides in the physical barrier method.

Regarding the urea or melamine-formaldehyde resin precondensates (important chemical agents for crease-and shrink resistant finishes and for improvement of resiliency of jute carpets) it is to be appreciated, that the work in this field has already started in the Chemistry and Technical Chemistry Departments.

It would be useful to develop a commercial method of production of resin precondensates for the Bangladesh Chemical Industry. Some kinds of fat modified resins for waterproofing also could be prepared as a derivative and put into the chemical industry. This seems to be a very important area for the investigations in Chemistry Department. The application of these chemical agents should be performed in Technology Division and then checked on a Pilot Plant scale.

The elaboration of rot-proofing methods is involved in the work programme of Biochemistry Department. Good results achieved by application of copper naphthenates should be transferred into the industrially applicable technology. Some experimental comparison work is done using various copper salts. Further a much more sophisticated method, a graft copolymerization of sodium acrylate on jute followed by ion exchange, might be studied in the Chemistry Department.

Work Programme

The above-mentioned problems are included into the Annual Work Programme for 1982.

In the field of chemical finishing there are following objectives:

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

This objective is divided into three projects:

DF Bleaching of jute materials

- 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

- a. To develop printing technic methods
- b. To study the physico-chemical aspects of printing

DF Dyeing of jute materials

- 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 study the chemistry of dyeing
- d. To measure fastness properties to washing and rubbing
- e. To measure colour changes due to light

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

This objective is divided into three projects. Two of them are connected with chemical finishing:

TC Study and prevention of photo-chemical changes in jute

- a. To establish chemical methods for prevention of yellowing 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

- a. To examine the effect on jute materials by treatment of alkali/liquid ammonia
- b. To measure crimp characteristics of the treated jute
- c. To measure thermal properties of mercerised jute and jute products

Objective No. 8 : To improve the market potential of jute products

Seven projects belong to this objective. Four of them are connected with chemical finishing. They are:

TC To improve resiliency of jute carpet

- a. To improve resiliency by chemical means
- b. Measurement of resiliency

C To develop suitable resin finish for jute materials

- a. Development of suitable resin finish for jute materials by using different monomers
- b. Measurement of physico-chemical properties of the products

TC To develop fire retardant process for jute

- a. By chemical means
- b. By physical barrier methods
- c. Measurement of the physical properties of the products

C To develop rot proofing process for jute

PP Objective No. 9 : Trial production and technical services

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

Objective No. 10 : Miscellaneous

The process for production of branding ink is included.

2.2.3. Relationship with the jute industry

The cooperation between BJRI (Tech) and the jute industry in the field of chemical finishing has been established. The expert has attended two

meetings regarding the close relationship between BJRI (Tech) and BJMC. The BJRI (Tech) also presented to the BJMC a list of training possibilities with the topic "Dyeing and finishing including woolenisation and bleaching - methods, application, testing and quality control".

Besides the government's industry some small firms which belong to the private sector are deeply interested in modern technologies for jute, offered by BJRI (Tech). They are for instance Bangladesh Small and Cottage Industries Corporation, Modern Dyeing and Screen-Printing Ltd. etc. The rapid dissemination of the research findings throughout the industry is only possible when the research staff will go to the industry to demonstrate the technical feasibility of the manufacture on new or improved jute products.

The publication of research findings in Institute's issues like "Bangladesh Journal of Jute and Fiber Research" and "Jute and Jute Fabrics" can be very helpful and advisable.

3. Activities of Expert

According to the UNIDO job description DP/BGD/75/013/11-52 consultant in chemical finishing of jute and jute products, attached to the Bangladesh Jute Research Institute (Technology) at Dacca was obliged to:

- Work with the counterpart on improving and developing processes for bleaching, dyeing, printing and finishing jute and jute products.
- Preparation of final report, setting out the findings of the mission and recommendations to the Government on further action which might be taken.

3.1 Research work arrangement

According to the above mentioned activities the expert has been oriented about the Bangladesh Jute Research Institute (Technology) concerning its objectives, organization and equipment. Special emphasis has been given

to the Dyeing and Finishing, Technical Chemistry, Chemistry and Pilot Plant Departments regarding their range of research work and their facilities. Relevant findings are given in this Report in Chapter 2.

The Expert participated in the preparation of the work programme of research for the year 1982 and evaluation of research work included in the Technical Report for the year 1981 concerning bleaching, dyeing, printing and finishing.

Expert's suggestions referring to the work programme and to the new technologies for various new jute products are submitted in Annexes IV, V, and VI.

The expert attended the Institute's meetings on the cooperation and coordination between the Bangladesh Jute Research Institute (Technology) and Bangladesh Jute Mills Corporation and on the proposed Training Courses which Institute can offer to the industry.

3.2 Consultations and demonstrations

Many direct consultations and advices (some of them with demonstrations) were given by the expert to the research workers in BJRI (Tech). Importance had been given to the following subjects:

- Continuous scouring of jute fabrics
- Alkali pretreatment followed by bleaching
- Dyeing according to "Pad-Jig" and "Pad-Roll" methods
- Bleaching and dyeing of jute in the same bath
- Printing technics, especially pigment printing
- Crease-resistant resin finish and the mechanism of crosslinking
- The graft-copolymerisation
- The selection of catalysts
- Fire-retardant finish and latest methods of effect's evaluation
- Water-and rot proofing and the methods of testing
- The finishing in organic solvents milieu .

3.3 Visits to factories

The expert visited four factories located in Dacca and its suburbs.

- Latif Bawany Jute Mills Ltd., - Demra
- Jute Plastics - Bangladesh Jute Mills Corporation - Tarrabo
- Ahmed Bawany Textile Mills Ltd. - Demra
- Ahmed Silk Mill Ltd. - Demra

All the factories except the last one belong to the Government sector.

Jute Products are made only in the first two factories. The Latif Bawany Jute Mills produces mainly carpet backing cloth and various kinds of bags, which generally do not need any special finishing, except calendering. The Jute Plastics uses jute cloth as a filler and reinforcing material for plastic furniture and plastic containers made by means of the imported epoxy-resins. The methods of production are primitive.

The real finishing department the expert has found belongs to the Ahmed Bawany Textile Mills Ltd., which is a producer of cotton fabrics. However, the existing Japanese and German machineries are generally old, they permit the continuous production of bleached (J-Box system), dyed and printed goods.

Because of lack of proper finishing equipment in the jute industry especially the machines which also till now do not exist in BJRI (Tech) could be used for jute products. They are as follows:

- Singeing machine
- 7 units washing machine
- Mercerizing machine
- Steamer
- Duplex roller printing machine (One in Bangladesh only)
- Screen printing machine
- Calender

The factory intends to prepare the screens itself in near future. The Ahmed Silk Mill Ltd. has only a finishing department, where various kinds of nylon and silk fabrics are dyed and printed. Printing is made on three, long tables by means of hand-operated screens. As a thickener the tragant gum is mainly applied.

4. Conclusion and Recommendations

4.1 Summary

The Bangladesh Jute Research Institute (Technology) at Dacca acting as the Government Institute, is the principal source of research and development work for the jute industry.

Since 1978 BJRI (Tech) received technical assistance from the United Nations Industrial Development Organization/United Nations Development Programme. The inputs are laboratory and pilot plant equipment, consultations, foreign training, and study tours for the high-level staff personnel. The BJRI (Tech) has now the required basic technical facilities to carry out the research work on a large scale. The need for the development of new products and new technologies for various jute products, respectively to the situation on the world textile market, can be realised on a pilot plant scale in the field of chemical pretreatment, bleaching, dyeing and finishing. The printing only is not included into the range of possibilities. The equipment for chemical technology represents international standard.

In last few years much progress has been made in the chemical pretreatment (woolenisation) and bleaching of jute yarn and fabric, but rather less in printing and dyeing. Actually the trials of some interesting methods of finishing (flame-proofing, rot proofing, crease-resistant finish) is being undertaken on a laboratory scale.

At present the progress on research is going on and moving towards right direction. The scope of research is specified every year in form of "Objectives".

The mutual relationship and cooperation between BJRI (Tech) and the jute industry is progressing as expected.

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 teams of research workers should be created irrespective of the divisional structure, to solve specified concrete projects or objectives.
2. Each of specified objectives has to be directed by one person, responsible for the results.
3. For each objective the ending form should be established. In most technological objectives it should be the application on the industrial scale.
4. All research teams should have the meetings at least every 2-3 months to discuss with persons concerned regarding the progress and difficulties encountered in research work.
5. It is necessary to demonstrate chemical technology processes to the industry and to conduct some training courses for the mill personnel.

Research work objectives

Among the projects specified in the work programme for current year especially five of them have for the jute industry a great importance. They are:

1. To study the dyeing properties of different classes of dyes and to establish standard dyeing methods for jute materials.
2. To develop printing technic methods.

3. To establish chemical methods for prevention of yellowing of natural and bleached jute.
4. To develop suitable resin finish for jute materials by using different monomers.
5. To develop fire retardent process for jute.

Special care should be taken to dissolve these projects in a possibly short period.

The research findings should be published in the Bangladesh Journal of Jute and Fiber Research.

Equipment

To supplement the equipment and the technical facilities some other machineries for the Pilot Plant are required.

1. A relatively simple "Rolling-device" necessary for the "Pad-Roll" method of desizing, bleaching, dyeing and resin finishing can be designed and constructed in Dacca.
2. The necessary machinery specified for the chemical finishing are as follows:

Shearing machine
Singeing machine
Flat screen printing machine
Steamer
Measuring-folding device
3. To have the jute textile production in international level it is necessary to use a wide range of new kinds of dyestuffs and finishing agents. It would be useful to develop a commercial method of production of resin pre-condensates.

4. The number of volumes concerning finishing in the library should be increased.

The subscription of at least few most important Journals like Textile World Abstracts, Journal of the Society of Dyers and Colourists, American Dyestuff Reporter, Textile Research Journal and Melliond Textilberichte (English edition) should be renewed for the year 1982 and the next years.

Annex I

Expert's Work Programme from 15 November 1981 - 14 February 1982

- 15 November, 1981 - Arrival and entry on duty
- 16 November, 1981 - Briefing in Vienna
- 17-18 November, 1981 - Departure from Vienna to Dacca through Rome and Abu Dhabi
- 19-31 November, 1981 - a. Lay out of the activities
b. Orientation of the Bangladesh Jute Research Institute (Technology) concerning its objectives and organization
- 1-31 December, 1981 - a. Familiarisation with the Dyeing and Finishing, Technical Chemistry, Chemistry and Biochemistry Departments concerning their range of research work, organisation and equipment
b. Participation in the Institute's meetings:
- on research work included in the Technical Report for the year 1981
- on suggested "Objectives" for 1982 Programme of Research
- on the cooperation between the Bangladesh Jute Research Institute (Tech) and the Bangladesh Jute Mills Corporation
- on the proposed Training Courses, which Institute can offer to the industry
- on the proposal of UNIDO/UNDP Project extension
- Visits to the Latif Bawany Jute Mills Ltd. and the Plastic Factories
- 1-31 January, 1982 - a. Review of the Institute's (Tech) Pilot Plant facilities
b. Review of the activities of the Pilot Plant Department
c. Consultations for BJRI (Tech) - staff members in the latest technics of chemical pre-treatment, dyeing, printing and finishing of jute goods

Annex I

- 1-31 January, 1982 - d. Work with the counterpart on improving and developing new processes for chemical finishing of jute and jute products
- e. Visits to the Ahmed Bawany Textile Mills Ltd. and the Ahmed Silk Mill Ltd. factories
- 1-7 February, 1982 - Preparation of the final report
- 8-10 February, 1982 - Departure from Dacca to Vienna
- 11-13 February, 1982 - Debriefing in Vienna
- 14 February, 1982 - Completion of assignment

Annex II

List of Machinery (existing and required) for
pretreatment, printing, dyeing and finishing

I Existing Pilot Plant Machinery

UNIDO/UNDP Inputs

1. For yarns:
 - a. Mercerizing machine with cooling, neutralizing and washing units
 - b. Drying and Curing machine

2. For fabrics:
 - a. Padder
 - b. Jigger
 - c. Washing machine
 - d. Stenter
 - e. Mercerising machine (under order)
 - f. Calender (under order)

BJRI (Tech) Inputs

1. For yarns:
 - a. Hydroextractor
 - b. Open tanks
 - c. High temperature dyeing machine
 - d. SDC wash wheel

Laboratory Machinery

UNIDO/UNDP Inputs

- a. Laboratory jigger
- b. Laboratory stenter

Annex II

BJRI (Tech) Inputs

- a. Yarn dyeing machine
- b. Package dyer
- c. Padder
- d. Fibre dyeing machine
- e. Garment dyeing machine
- f. Winch
- g. Hydroextractor

II Required Pilot Plant Machinery

- a. Shearing machine
- b. Singeing machine
- c. Steamer
- d. Screen printing machine
- e. Rolling device (to be constructed in Dacca)
- f. Measuring and Folding machine

Annex III

DYEING AND FINISHING SHED PROCESSING SCHEDULE BJRI (TECH)

• Remarks

V - applicable

X - non applicable

Process	Materials		Machine		Remarks
	Yarn	Fabrics	Yarn	Fabrics	
1. Pretreatments a. Desizing & scouring b. Scouring	X V	V XV	X Open tank	Fadder and Washing Machine Jigger	
2. Woolenisation	V	V	Open tank or yarn mercerising machine	Padder and Washing machine	Requested for a fabric mer- cerising machine
3. Bleaching	V	V	Open tank or package dyer	Jigger or padding rolling and washing machine	Rolling system to be developed
4. Dyeing	V	V	Package dyer and Package dryer	Jigger or padding rolling and washing machine	Package dryer is actually not in operation
5. Printing	X	V	-	Screen printing; steamer	Hand screen printing - on the laboratory scale only; screen printing machine and steamer to be procured
6. Finishing a. Softening b. Resin finish, crease re- sistance fabrics or im- proved resiliency of yarn c. Flame proofing d. Water repellency e. Rot proofing	V V XV X X	V V XV XV XV	Open tank and Package dryer " " - -	Padder and stenter " " " "	
7. Calendering	X	V	X	Calender	Requested for a Calender

Annex IV

Work Programme
in the Bangladesh Jute Research Institute (Technology)
in the field of Chemical pretreatment, Bleaching
Dyeing, Printing and Finishing

The activities of the above mentioned Department will be carried out in the year 1982 in the following fields:

- I Chemical pretreatment
 i.e. scouring, desizing, alkali treatment, bleaching
- II Dyeing
- III Printing
- IV Finishing

Research work will be based both on the laboratory and pilot plant-scale trials.

Ad I. Pretreatment re. obj. no. 6 Dept. DP and PP

The technique to be used for the pretreatment depends mainly on the type and quality of the textile material and the object of pretreatment.

In order to develop new industrially applicable technologies for jute products by means of existing equipment with comparatively less cost, following research studies are recommended:

For unbleached, later printed fabrics

- Scouring according to frame-recipe 1 in the full-width washing machine.

Advantage of the method: continuous scouring by speed 60-70 metres/min, which ensures the high production level.

According to the type of jute fabric to be scoured it is necessary to establish:

- concentration of chemicals in the washing units
- scouring time and temperature in the washing units
- rate of water flow through the washing machine.

For fabrics with special kind of finishes

- Desizing according to frame-recipe 2

Determination of the degree of purification (starch content before and after scouring), as well as the strength characteristic of the treated fabrics are essential.

For bleached goods (which do not need the woolenisation)

- alkali-pretreatment for yarns or for fabrics in rope form in the package dyer followed by bleaching in the same machine - according to frame - recipes 3, 4, 5.

Advantages of the method:

- high production level - important for the industry - by means of the big capacity package dyers.
- extraction of the impurities and improvement of the absorptivity achieved by boil-off with alkali.
- good decoloration of the lignin achieved by bleaching.
- soft handle of treated goods.

According to the type of jute to be bleached it is advisable to carry out and compare the results achieved by:

- Peroxide bleach
- Hypochlorite bleach
- Sodium perborate bleach

In finding the most economic process attention should be given so that the alkali boiled-off and bleached jute products exhibit:

- minimum loss in weight
- maximum tensile strength
- maximum degree of whiteness

All these above mentioned factors should be checked.

Ad II. Dyeing re. obj. no. 6 Dep. DF and PP

In order to establish standard dyeing methods and obtain the dyed jute materials having good fastness to washing, rubbing and to light following research studies are recommended:

For bleached, coloured goods (both made of 100% jute and union & blended fabrics)

- Dyeing with direct cotton dyes

Special trials should be carried out at first on the laboratory scale to select the dyestuffs with proper fastness to light on dyed jute.

Then the results should be confirmed on the pilot plant scale.

A special methods of simultaneous dyeing and bleaching with direct dyes and peroxide bleach according to Bayer recipe 9 is to be checked.

- Dyeing with reactive dyestuffs
including:

- a. Method of dyeing on jigger (Pad-Jig) - process - according to frame-recipe 6
- b. Method of dyeing in the (Pad-Roll) - process - according to frame-recipe 7.

Remarks:

The method 'b' i.e. "Pad-Roll" requires additionally a "Roll" device (to be designed and constructed in Dacca). For padding the existing padding-mangle can be used.

Pigment dyeing

(Pad-Dry-Cure-method) - by means of pigment-dyes and binders - according to recipe 8.

In all methods of dyeing the determination of the fastness properties to washing, rubbing (in dry and wet states) and light exposure of the dyed jute products are essential.

Ad III. Printing re. obj. no. 6 Dept. DF and PP

The technique to be used for printing of jute fabrics is especially based on the application of the pigment dyestuffs and reactive dyestuffs.

In view of the development of printed goods with good fastness properties following research studies are recommended:

For grey, white or coloured printed fabrics

- pigment printing on a screen printing device according to frame recipe 9 by means of:
 - a. Emulsion thickening type O/W with mineral spirits in full amount
 - b. Emulsion thickening type O/W with limited amount of mineral spirits
- printing with reactive dyestuffs using common thickening (sodium alginate only) according to frame-recipe 10.

The main advantages of the pigment printing are as follows:

- the emulsion thickening is simple to prepare by means of a high-speed mechanical stirrer

- the fastness properties are very good except rubbing fastness in wet and dry states, which is called as "sufficient" (3 in the 5-step scale)
- no after-washing is required.

As a disadvantage the application of the highly flammable spirits ought to be mentioned.

The printing with reactive dyestuffs permits to avoid the use of the emulsion thickenings. But good results are obtainable if the steaming process is carried out after printing (steamer required). In this case printing is followed by washing, rinsing and drying with optional steaming before washing.

It is necessary to check the fastness properties to washing, rubbing (in dry and wet states) as well as the colour change due to the exposure to sunlight.

Ad IV Finishing re. obj. no. 8 -Technology Division

Dep. C
Dep. PP
Dep. BC

The purpose of finishing is to improve the handle, appearance and serviceability of a material. Special effects can be achieved with an appropriate finish.

The technique to be used for the finishing depends mainly on the end-use of the jute material.

In the field of finishing following research studies are recommended:

Crease and shrink-resistant resin finish

- in order to improve the resiliency of jute carpet and the market potential of some apparel goods. Research work should be carried out for yarn and fabric -

by means of:

- a. urea - or melamine - formaldehyde precondensates, prepared in the Chemistry Department, adjusted to technical application in the Technology Division and checked at the end on the Pilot Plant scale.
- b. the commercial imported products, available in Bangladesh (e.g. Lyofix CEN-Ciba-Geigy) or Kaurits-BASF for Pad-Dry-Cure Process (see recipe 12) or Fixapret CPN-BASF - for Moist-Crosslinking - (see recipe 13).

Flame - retardant finish

- in order to develop fire retardant process for curtains, upholsteries etc. Research studies should be carried out for fabric as well as for yarn -

by means of:

- a. urea - or melamine - formaldehyde precondensates prepared in the Chemistry Department and adjusted to the technical application in the Technology Division in combination with phosphorus or boron compounds according to recipe 15 or chemical method based on research work carried out in the Technical Chemistry Department.
- b. the imported commercial products i.e. Pyrovatex CP (Ciba-Geigy) - see recipe 14.
- c. by physical barrier method - based on research work carried out in the Chemistry Department.

Waterproof finishing and combined water-and rot proofing processes

- in order to develop a finishing process suitable for canvas material, tarpaulins etc. based on:
- a. paraffin emulsion containing aluminium or zirconium salts used together, if necessary, with copper salts, according to recipe 16.
 - b. fat-modified melamine resins according to recipe 17, by means of commercial products or agents prepared in the Chemistry Department, adjusted to the technical application in the Technology Division and checked on the Pilot Plant scale.

Rotproof finishing

Topic for the Biochemistry, Chemistry and Pilot Plant Departments

Because of good results achieved in research studies in the Biochemistry Department carried out on the laboratory scale by means of copper naphthenates some experimental trials should be done on the pilot plant scale. The main objective of the work is to establish the procedure that can be used in the industry.

Some research work is to be recommended on the laboratory scale for the Chemistry Department concerning new method of the graft copolymerization of sodium acrylate on jute fabric followed by ion exchange with copper salt.

Stiff finishing

Topic for the Technology Division

Finishing for tapestries etc. - by means of:

- a. pigment dyeing by the addition of reactive copolymers derived from acrylate in order to modify the handle from full to stiff according to recipe 8.

- b. common starch or modified starch - resin precondensates stiff finish ("Pad-Dry-Cure" process) according to recipe 18 - followed by calendering (Calender required).

Generally speaking for the finishing process good wetting out and absorbance of the jute are important prerequisites for the finishing liquor to penetrate uniformly into the material. Hence the pretreatment should be done very carefully.

It should also be remembered that in resin finishing the losses in strength on drying are greater when the residual moisture content is lower, and when the temperature and the reaction time are increased.

Then the determination of the degree of purification before finishing as well as the resin add-on and strength characteristic of the treated (in comparison to untreated) goods are essential. The special finishing effects on goods should be tested according to existing standard methods.

All the above mentioned recommendations and frame-recipes do not cover all the topics which are interesting and worthy from the theoretical, technical and economical point of view. There are some suggestions concerning especially the possibilities for BJRI (Tech) and for jute mills to put new technologies into the practice.

Annex V

New Technologies for various products made of jute. Frame-recipes

C O N T E N T S

- Recipe 1 - Scouring
- Recipe 2 - Desizing
- Recipe 3 - Alkali pretreatment followed by Peroxide Bleach
- Recipe 4 - Alkali pretreatment followed by Perborate Bleach
- Recipe 5 - Alkali pretreatment followed by Hypochlorite Bleach
- Recipe 6 - Dyeing with reactive dyestuffs. The "Pad-Jig" Method
- Recipe 7 - Dyeing with reactive dyestuffs. The "Pad-Roll" Method
- Recipe 8 - Pigment dyeing with handle modification
- Recipe 9 - Bleaching and dyeing of jute in the same bath with selected direct dyestuffs
- Recipe 10 - Pigment printing
- Recipe 11 - Printing with reactive dyestuffs
- Recipe 12 - Crease-resistant and shrink-resistant resin finish "Pad-Dry-Cure" Process
- Recipe 13 - Crease-resistant resin finish Moist-Crosslinking Process
- Recipe 14 - Fire-retardant finish by means of organic phosphorus compounds
- Recipe 15 - Fire-retardant finish by means of non-organic phosphorus compounds
- Recipe 16 - Waterproof finishing and combined water-and rot proofing methods
- Recipe 17 - Waterproof finishing based on fat-modified melamine resin
- Recipe 18 - Stiff finish (washfast)

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Recipe 2

Desizing

Procedure for the fabrics for special finishes.

Necessary equipment: padding mangle
rolling device *
washing machine
stenter

The previously singed/sheared jute fabric is impregnated in full width in the padding mangle with the liquor containing:

2-3 g/l desizing enzyme - Diastase
0.5 g/l wetting agent non-ionic (for instance Nekanil LN (BASF),
Lissapol N (ICI)
pH 6-6.5 (adjusted by means of acetic acid)

Liquor pick-up 70-80% according to the quality of fabric.

Treating temperature: 60°C

The padded fabric is rolled up on a roller wrapped with plastic sheet and stored 4 hours at room temperature. Rotation of the roll during the desizing time is recommended.

This procedure is followed by washing in a full-width washing machine in hot and cold water and drying on stenter.

Remark *

The method requires a rolling device (to be designed and constructed in Dacca).

Recipe 3

Alkali pretreatment followed by Peroxide Bleach

Procedure for bleached goods.

1. Shearing (once for both sides) | for fabrics only.
2. Singeing (once for both sides) |
3. Alkali - pretreatment
for yarns or for fabrics in rope form

Alkali pretreatment

Necessary equipment: package dyer
open tank
padding mangle | for fabrics only
and stenter |

Wet yarn or fabric in rope form wetted before in open tank is treated in package dyer in the bath containing:

6 g/l	Sodium Hydroxide
4 g/l	Sodium Carbonate
1 g/l	Wetting agent anionic (e.g. Leophen U - BASF)
2 g/l	Sodium Disulphite (Na HSO_3)

Treating time: 1 hour; Liquor ration 1:10

Treating temperature : 100°C : change in the direction of bath's circulation - every 5 minutes

Cooling and rinsing with cold water for 40 minutes.

4. Peroxide Bleach

The goods remain in the same package dyer.

The bleaching liquor contents:

8ml/l	Hydrogen Peroxide	30%
4ml/l	Sodium Silicate	42° Be'
1 g/l	Wetting agent (nonionic or anionic)	

Recipe 4

Alkali pretreatment followed by Perborate Bleach

No. 1, 2 and 3 and the necessary equipment as in Recipe 3.

4. Perborate Bleach

The bleaching liquor contents:

12 g/l	Sodium Perborate
4ml /l	Sodium Silicate 42° Be
1 g/l	Wetting agent (Nonionic or anionic)

Treating time: 1 hour at 75°C

Cooling and rinsing 40 minutes with cold tap water till pH = 7.

Recipe 5

Alkali-pretreatment followed by Hypochlorite Bleach

No. 1, 2 and the necessary equipment as in Recipe 3.

3. Alkali-pretreatment

Wet yarn or fabric in rope form is treated in package dyer in the bath containing:

10 g/l	Sodium Hydroxide
4 g/l	Sodium Carbonate
2 g/l	Sodium Bisulphite (preventing agent)
1 g/l	Sosp

Liquor ratio : 1:10

Temperature : 100°C

Reaction time : 2 hours (change in the direction of bath's circulation - every 5 minutes)

Rinsing with hot and cold water for 30-40 minutes till pH = 7-8.

4. Bleaching (Hypochlorite Bleach)

The goods remain in the same package dyer.

New bath contents:

4 g/l	Sodium Hypochlorite 30%
95 g/l	Wetting agent (anionic)
pH	10-11

Temperature : 18-22°C (room temperature)

Reaction time : 3 hours

The anti-chlorinate neutralization by means of sodium bisulphite 3 g/l.

Rinsing with cold tap water at temperature 18-22°C for 15 minutes till pH = 6-7.

Treating conditions:

1 hour at temperature 55°C
then 5 minutes at temperature 100°C.
Cooling and rinsing for 40 minutes with cold tap water till pH = 7.

Remarks for fabrics:

The rinsed fabric should be diverted from rope form into the full width
in a padding mangle and dried on stenter.

Recipe 6

Dyeing with reactive dyestuffs

The "Pad-Jig" Method

The Pad-Jig process is particularly suitable for the dyeing of close-weave fabrics or materials made from high-twist yarns.

Procedure for bleached, coloured fabrics:

1. Shearing (once for both sides)
2. Singeing (once for both sides)
3. Alkali-pretreatment
 - 3.1 Desizing and Scouring or
 - 3.2 Woolenisation
4. Bleaching
5. Dyeing

Dyeing

Necessary equipment: padding mangle
jigger
stenter

The jute fabric is at first padded at room-temperature in a padding-mangle with liquor containing:

X g dyestuff (the amount depends on the weight of the fabric
and on the depth of shade)
2 g/l wetting agent (anionic)

Liquor pick-up 70%

Then the wet fabric is directed into the jigger, and is subjected to following procedure: (by liquor ratio 1:5)

2-4 passages in the bath containing
60 g/l sodium chloride
at temperature 50°C
15 g/l sodium carbonate and
6 g/l sodium hydroxide
should be added to the bath in two equal instalments
and are given 2 passages at temperature 60°C.

then
6-8 passages - in the bath containing all these mentioned
components should be at temperature 70°C .

Remark:

Sodium carbonate and sodium hydroxide should be added in dissolved form.

Time of dyeing in jigger with all ingredients - 90 minutes at temperature 70°C .

To achieve optimum wet fastness properties, unfixed dyestuff must be removed from the fibre by thorough rinsing and soaping.

The following procedure should be used:

- a) rinsing in jigger in cold and hot water
(temp. 50° - 70°C) for 10 minutes.
- b) soaping in bath containing 4 g/l detergent at temperature
 70°C - 80°C for 10 - 20 minutes.
- c) rinsing in luke-warm and cold water
- d) drying on stenter.

Recipe 7

Dyeing with reactive dyestuffs

The "Pad-Roll" method

Procedure for bleached, coloured fabrics.

No. 1 - 5 as in recipe 6

Dyeing

Necessary equipment: padding mangle
rolling device (in a chamber)
jigger
stenter

The jute fabric is at first padded at temperature 20-40°C in a padding mangle with liquor containing:

X	g	dyestuff (depending on material and depth of shade)
50-200	g/l	urea (to improve the dyestuff solubility)
20	g/l	sodium carbonate
1-2ml	/l	sodium hydroxide (density 1,33)
5-20	g/l	sodium sulphate (Glauber Salt)
2-4	g/l	wetting agent

Liquor pick-up 70-80%

The solutions of dyestuff and of the alkali-reagents should be prepared in the separate containers and mixed just before padding.

The padded fabric is rolled up on a roller in a reaction chamber and stored in the closed chamber 4-6 hours in wet atmosphere at temperature 80°C until final fixation is attained. Rotation of the roll during the fixation time is required.

At the end the washing and rinsing - as in Recipe 6.

Recipe 8

Pigment-dyeing with handle modification (BASF-method)

Procedure for bleached, coloured fabrics.

No. 1 - 5 as in recipe 6

Pigment Dyeing

In pigment dyeing of jute fabric, Helizarin binder F improves the fullness of the handle. It is possible to modify the handle from full to stiff by the addition of Perapret F (a reactive copolymer on the acrylate basis).

Necessary equipment: padding mangle
stenter

Padding liquor contents:

X	g/l	Helizarin
50-100	g/l	Helizarin Binder F
10-50	g/l	Perapret F, if necessary

Padding should be adjusted at the lowest possible pick-up (about 60%).

Drying and curing on stenter.

Curing time: 7 minutes at temperature 140°C.

Recipe 9

Bleaching and Dyeing of jute in the same bath

(with selected direct dyestuffs)

Bayer-recipe

Procedure for bleached, dyed goods.

No. 1, 2 and 3 as in Recipe No. 1

4. Simultaneous bleaching and dyeing

Necessary equipment: package dyer
 package dryer

The goods are treated in liquor containing:

1	g/l	Levepon TH (Bayer((Wetting agent)
8ml	/l	Hydrogen Peroxide 35%
4ml	/l	Caustic Soda 38° Be
4	g/l	Sodium Silicate
X	%	Glauber Salt (e.g. 5% for 0,25% Dyestuff) 15% for 2% Dyestuff

Bleaching and Dyeing technique:

Run 15 minutes at 40°C, add dyestuff and maintain temperature for another 10 minutes. Heat up within 30 minutes to 90°C. Maintain 90°C for 30 minutes. Rinse until all oxidizing products are removed. Dry in the package dryer.

Recipe 10

Pigment-Printing

Procedure for grey, white or coloured printed fabrics.

1. Shearing (Once for both sides)
2. Singeing (once for both sides)
3. Alkali-pretreatment
 - 3.1 Desizing & Scouring
 - or 3.2 Woolenisation
4. Bleaching (if desired)
5. Dyeing (if desired)
6. Printing

Pigment-Printing

Necessary equipment: hand-operated printing machine
mechanical stirrer (rotational speed about
2000 cycles/min.)
stenter

Preparation of the emulsion thickening

Type Oil/Water by means of Luprintol PL (BASF) as an emulsifier.

70 g water
10 g Luprintol PL (BASF)
60 g Sodium Alginate 4%
20 g Urea

All the above mentioned components are mixed together and then are incorporated with rapid stirrer:

690 g white spirit
then
30 g ammonium sulphate solution 1:3
and finally
120 g Helizarinbinder UD (BASF)

Total: 1000 g

Preparation of the Emulsion Print Paste

Mix 10 - 60g pigment dyestuff per 1 kg of the above mentioned emulsion.
Printing by means of the hand-operated screen printing device.

Curing on stenter

7 minutes at temperature 140°C
or 5 minutes at temperature 150°C

No washing required.

Recipe 11

Printing with Reactive Dyestuffs

Procedure for printed fabrics.

No. 1, 2, 3, 4, 5 as in Recipe 10

6. Printing with reactive Dyestuffs

Preparation of the Printing-Paste

50-200 g urea dissolved in
400-250g water are heated at temperature 40-50°C
then

30-60g dyestuff is added and dissolved and all the components are put into
510-477g sodium alginate thickening (pre-pasted with water).

At the end (after cooling to room temperature)
10-13g sodium bicarbonate (Na HCO_3) (pre-dissolved in small amount of water)
is mixed together.

1000g - Total

Printing by means of hand-operated screen printing device.

Steaming 30 seconds - 2 minutes.

Washing and rinsing as in Recipe 6.

Recipe 13

Crease resistant resin finish

Moist Crosslinking Process

Moist crosslinking is a finishing process that is carried out on partially swollen cellulosic fibre fabrics with a defined residual moisture content.

Necessary equipment: padding mangle
rolling device
full width washing machine
stenter

The jute fabric should be carefully desized, mercerized, neutralized and washed off before treatment.

Padding on padding mangle with the liquor containing:

250-300		reactant type resin based on DMDHU (dimethyloldihydroxy-ethylene urea) (e.g. Fixapret CPN-BASF)
20-30	g/l	polyethylene dispersion (e.g. Perapret PE-40-BASF)
20-30	g/l	polyacrylate dispersion (e.g. Perapret HVN-BASF)
2-3	g/l	non-ionic wetting agent (e.g. Nekanil LN-BASF)
15-20	g/l	catalyst (e.g. Condensol FN-BASF-which consists of inorganic acids and organic compounds specially developed for the moist crosslinking process)

Liquor pick-up 70%.

The additives like polyethylene - and polyacrylate dispersions are recommended to cut down the loss of tear strength and abrasion resistance and to improve the crease-recovery.

Drying on stenter at 80-100°C to the residual moisture content 9-10%.
The prescribed residual moisture must be maintained accurately to within
± 1-2%. After drying the material is batched (in rolled form), wrapped
in a plastic film, and allowed to stand for 16-24 hours at room temperature.

After this reaction time the fabric is subjected to rinsing and neutralization operations in a full width washing machine.

Rinsing and neutralization.

First bath : cold water

Second bath : 5 - 10 g/l soda ash, cold

Third bath : 2 g/l soda ash + 2g/l soap, 50°C

Fourth bath : water at 40°C

Fifth bath : water at pH 5 (with acetic acid), cold

Sixth bath : cold water

Drying on stenter.

Recipe 14

Fire-retardant finish
by means of organic phosphorus compounds

Necessary equipment: padding mangle
stenter
full-width washing machine

Carefully desized and neutralized (mercerized or not mercerized) jute fabric is padded at temperature 25-30°C with the bath prepared as follows:

300-400	g/l	a fibre-reactive phosphorus compound (e.g. Pyrovatex CP-Ciba-Geigy)
80	g/l	melamine-formaldehyde compound (e.g. Lyofix CHN-Ciba-Geigy)
1	g/l	non-ionic wetting agent are mixed together with cold water, then,
20	g/l	softener (e.g. Turpex ACN-a non-ionic polyethylene emulsion- Ciba-Geigy)
25	g/l	phosphoric acid 85% are bulked with water and added together and adjusted to the required volume.

Liquor pick-up about 90%.

Then drying on stenter with overfeed at temperature about 150°C and curing 5 minutes at 150°C.

As the finish is hygroscopic in the uncured state, curing should immediately be after drying.

The drying and curing units should be well ventilated to eliminate any formaldehyde vapour formed during the respective operations.

After curing, the fabric should be washed off with soda ash in a full width washer and dried on stenter within 24 hours. This treatment is essential if the treated goods are to be odourless and soft.

If the fabric is to stiff it can be softened additionally after washing off. It is treated with 20 g/l Turpex ACN wet-on-wet. The last operation - drying on stenter.

Recipe 16

Waterproof finishing and combined water-and rot proofing methods

Process suitable for canvas material and tarpaulins.

Necessary equipment: padding mangle
stenter

A good pretreatment (desizing, washing off) of the jute fabric is essential for good results in water-repellent finishing, because many types of textile auxiliaries, especially surfactants that are used as detergents, are liable to impair the water-repellent effect.

Also good water repellency can be obtained on fabrics with a smooth surface (obtainable by shearing and singeing).

For waterproofing the jute fabric is padded at room temperature with the liquor made of:

100-150	g/l	Paraffin emulsion containing aluminium salt (e.g. Ramasit K-BASF)
25-50	g/l	Non-ionic aqueous polyvinyl acetate dispersion (e.g. Perapret VA-BASF) (used as filler if necessary and to improve the waterproofness of the fabric).

Liquor pick-up about 80%

The impregnation is followed by drying on stenter. For combined water - and rotproofing effects

20-30 g/l copper acetate should be added to the padding liquor. Its colour, however, is liable to change the shade of the fabric.

In view of the requirements placed on the light fastness, canvas material for tents is dyed also with pigments according to recipe 8. The water-repellent finish must, in this case, be carried out following an intermediate washing.

Recipe 17

Waterproof finishing
based on fat-modified melamine resin

Necessary equipment: padding mangle
stenter

A good desized, free from alkali, salt residues and surface active substances jute fabric is padded at room temperature with liquor containing:

40-80	g/l	Phobotex FTC new (Ciba-Geigy) ** or correspondent fat modified melamine resin prepared in the Chemistry Department
5-10	g/l	acetic acid 80%
2-4	g/l	aluminium sulphate cryst.

Remark **

The product cannot be dissolved or emulsified directly. It must be melted with hot water then emulsified with acetic acid.

Liquor pick-up about 80%

The impregnation is followed by drying at moderate temperature about 100°C and curing 5 minutes at 140°C on stenter.

Recipe 18

Stiff finish (Washfast)

Necessary equipment: padding mangle
stenter

The carefully desized jute fabric is padded at room temperature with the bath containing:

50 g/l	Alkyl modified melamine-formaldehyde derivatives (e.g. Lyofix CH Ciba-Geigy) or corresponding product prepared in the Chemistry Department of BJRI (Tech).
upto 100 g/l	modified starch or soluble starch derivative
upto 50 g/l	additive for improving the tensile strength and abrasion resistance (e.g. Turpex KM - Ciba-Geigy)
10 g/l	catalyst, based on a magnesium salt (e.g. Knittex Catalyst MO Ciba-Geigy)

Liquor pick-up 70-80%

Drying on stenter at 110°C

Curing 4-5 minutes at 135-140°C.

Annex VI

Recommended procedures for various products made of jute

Articles	Pretreatment (Desizing, Scouring)	Woolenisation or Alkali pretreatment	Bleaching	Dyeing	Printing	Finishing	Calendering	Remarks
1	2	3	4	5	6	7	8	9
furnishings (curtains, upholsteries, wall-coverings, decorative napkins, tablecloth etc.)	According to recipes 1, 2	BJRI (Tech) method or recipe 3	BJRI (Tech) method or recipes 3, 4 or 5	a. With reactive dyes-re. 6 "Pad-Jig" or re. 7 "Pad-Roll" b. With direct dyes-acc. to dyes producer's recipes modified for jute or re. 9 c. With pigments- re. 8	If desired a. With pigments re. 10 b. With reactive dyes re. 11	If desired a. flame resistant finish re. 14 or 15 b. stiff-finish re. 8 or 18	On 3-bowl calender at 60°C for all fabrics	Woolenisation for curtains and upholsteries only
Clothing textiles (made of grey, half or full bleached, white or coloured yarn)	re. 1,2	BJRI (Tech) method for yarns or fabrics or re. 3	BJRI (Tech) method for yarns or fabrics or re. 3, 4 or 5	as for furnishings except re. 8	If desired re. 11	Crease or shrink resistant finishes re. 12 or 13	"	-
Carpet and Carpet Backing Cloth	BJRI (Tech) method for yarn, re. 1 for carpet backing cloth	BJRI (Tech) method for yarns or re. 3	BJRI (Tech) method for yarns or re. 3, 4, 5 or 9 (combined with dyeing)	a. With selected direct dyes -re. 9 b. With reactive dyes in package dyer	-	If desired flame-resistant finish re. 14 or 15; crease resistant finish re. 12 or 13	"	For carpets procedures for yarns; for carpet backing cloth: scouring or finishing only.

Annex VI

Recommended procedures for various articles made of jute

Articles	Pretreatment (Desizing, Scouring)	Woolenisation or Alkali pre- treatment	Bleaching	Dyeing	Printing	Finishing	Calendering	Remarks
1	2	3	4	5	6	7	8	9
Blankets	BJRI (Tech) method	BJRI (Tech) method	BJRI (Tech) method	Re.6,7 or with selected direct dyes	-	Softening & Raising	no calen- dering	-
Canvas material and tents	re. 3	-	re.3,4, or 5	re. 8	-	Water-and-rot proofing-re. 16 or 17	On 3-bowl calender at 60°C	-
Sand bags	re. 1	-	-	-	-	Rot proofing with Copper naphthenate	-	To apply the results in ro proofing re- ceived in BJR on the labora- tory scale
<p>Remarks: * Desizing is unavoidable of some special finishes (crease-resistant, water-, flame and rot proofing etc.) are applied. ** Especially for wall-coverings and curtains with good light fastness properties.</p>								

