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JUTE RESEARCH AND DEVELOPMENT

DP/IND/86/037/11-13

INDIA

Technical report: Review of and recommendations on IJIRA's research and development work on the bleaching and dyeing of jute*

Prepared for the Government of India

by the United Nations Industrial Development Organization,

acting as executing agency for the United Nations Development Programme

Based on the work of Peter F. Greenwood
Textile chemist

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

United Nations Industrial Development Organization

Vienna

* This document has not been edited.

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Explanatory notes

Local currency:

U.N. exchange rate U.S.$ = 18 Indian Rupees

Abbreviation

ISO International Organization for Standardization

ABSTRACT

Project title: Jute Research and Development (Development and Promotion of Diversified End-Uses of Jute).

Project no.: DP/IND/86/037

Objective: Support of the research and development work carried out by the Indian Jute Industries Research Association (IJIRA) and of its industrial application.

Duration of mission: Two weeks
(18 February - 2 March 1991)

Conclusions and Recommendations

The work so far carried out by IJIRA has shown that jute can be dyed with a wide range of dyes to produce attractive and decorative fabrics. Certain fastness properties will have to be improved to achieve full commercial acceptance.

Other disadvantages may be hairiness and, especially for apparel, a rather harsh handle. Suggestions have been made for possible improvements. Advice to overcome unlevel dyeing problems has been given.

Some promising products have been developed in the course of this project but a full commitment of financial backing by the industry will be essential to ensure successful commercialisation.

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INTRODUCTION

This project to develop new end-uses for jute began in 1987, and is planned to be completed by mid-1991. The Programme was therefore at an advanced stage at the time of the present mission, which covers the period 18 February - 2 March 1991.

The job description for the present mission is reproduced as Annex I. This is the third mission under this post title; the previous missions were carried out by Dr. L.W.C. Miles, of Manchester, U.K.

The main problem areas presented by the IJIRA technical staff to this expert at the start of the mission were:

- the need to improve light fastness of bleached and dyed jute products,
- the hairiness of jute yarns and fabrics,
- unlevel results in package dyeing of yarns,
- fibre shedding.

These problems are addressed in this report. Some suggestions have already been made as a result of earlier missions.

I. REPORTS OF EARLIER MISSIONS

After the two previous missions, Dr. Miles made several suggestions for improving the quality of the products then being developed. The main ones were:

- that stenters should be installed in some of the co-operating mills, to control dimensions, improve handle and remove loose fibre,

- that a singeing machine should be installed to reduce hairiness,

- that chemical crosslinking before bleaching might improve wet strength.

Discussions with IJIRA staff and co-operating mills during the present mission indicated that

- purchasing a stenter had been rejected due to cost,

- singeing trials had been carried out, but the results were not considered good enough to justify the purchase of singeing equipment,

- pad-dry-bake crosslinking trials had not given promising results, but experiments on moist-cure and wet crosslinking systems were being planned.

II. COMPANY VISITS

A. Birla Jute Mills,
Birlapur 743 318,
24 Parganas (S),
West Bengal.

Mr. G.D. Dadoo, President (Works)
Mr. V.K. Sharma, Vice-president (Works)

Visited on 26 February 1991.

The yarn dyeing plant described in Dr. Miles' reports is now functioning with some minor problems. The drying unit is being modified to handle the high moisture content of the jute packages. After vacuum extraction, this was said to be about 80%, compared with 50% for cotton yarn. The 40-spindle spiral winding unit is operating with 10 spindles only, due to missing parts.

Most classes of dyes have been used successfully, with the exception of basic dyes. Undyed spots frequently occur in cheese dyeing. Causes for this, and possible remedies, are discussed in Chapter IV.

B. Anglo-India Jute Mills Co. Ltd.,
P.O. Jagatdal, PIN 743 125,
24 Parganas (N),
West Bengal.

Mr. B.N. Kochhar, Director,
Mr. S. Dutta.

Visited on 27 February 1991.

The main item of UNDP equipment in this mill is an enclosed jig from Marubeni (Japan). This is a nice unit, fully controllable.

Dyeings on 100% jute have been used by IJIRA to produce a shade card (described further in Chapter III). A range of dyeings on a jute-cotton union cloth (jute warp, cotton weft) using direct, reactive and 1:2 premetallised dyes has been completed. It was interesting to note that the reactive dyes produced much deeper shades on jute than on cotton in competitive dyeing.

Mr. Dutta is very enthusiastic about the potential of this jute-cotton union fabric for curtains, because of its good draping properties.

Fabric drying is being carried out on a set of steam-heated cans taken from a sizing range. A new set of drying cans, and a pad-mangle, are on order, but there will still be no means for controlling cloth dimensions.

III. DEVELOPING PRODUCTS AND END-USES

End-uses planned by IJIRA for jute-based products include curtains, wall-coverings, soft luggage, upholstery, geo-textiles and apparel. For furnishing fabrics (curtains, wall-coverings and upholstery) good light fastness is essential, probably not less than 5 to the ISO test.

Fabric for soft luggage will be PVC-coated, for which the natural hairiness of the jute may be an advantage to some extent, giving good adhesion, although some shearing is necessary to remove the longest fibres. This will be even more important for apparel, where a smooth surface is desirable for comfort. Stability and easy-care will also be essential.

The bio-degradability of jute makes it very suitable for geo-textile applications. However, such products must be available cheaply, and profit margins may be low.

One shade card has been produced. This is directed towards furnishing and decorative end-uses and includes recipes and methods for

a) preparation of jute yarns and fabrics for dyeing,

b) dyeing with acid, 1:2 metal complex, direct and sulphur dyes,

c) coloration with pigment-binder systems.

Data on fastness to light, washing and rubbing are included. Washing and rubbing fastness is generally adequate, but light fastness of some dyeings is as low as 3 on the ISO scale, which is not good enough for furnishings.

This should be a useful guide for dyes in the development of jute furnishing products.

A second shade range, including reactive, basic and vat dyes is being prepared.

A manual for the dyeing and chemical processing of jute-based yarns for handloom weaving is also being prepared.

IV. TECHNICAL PROBLEMS.

A. Package dyeing with basic dyes.

Basic dyes give bright colours on jute. They are cheap and can be dyed directly on to unbleached jute without the need for mordants.

A problem has arisen in the package dyeing of jute yarn, whereby undyed spots frequently appear. These could be due to

- air bubbles due to poor wetting-out,
- uneven liquor circulation due to variations in package density,
- dye "striking" too quickly and not levelling.

Examination of the dyed yarn showed that surface dyeing was general throughout the package, indicating a fast strike and absence of levelling. The use of a retarding agent, for example Matexil LC-RA (ICI), may be helpful.

Poor wetting out could be caused by the use of an unsuitable wetting agent. Another ICI product, Dispersol VL, is currently being used, and the suitability of these products will be discussed with ICI in Manchester.

Improved wetting-out may be achieved by immersing the yarn packages in hot water prior to dyeing.

B. Hairiness.

Singeing has already been suggested as a remedy for hairiness. The material can be treated in either yarn or fabric form. Cropping, or shearing, the finished cloth may also be effective.

The use of a cellulase enzyme has been claimed to produce a smoother surface on cotton fabrics (1). IJIRA was advised to consult Novo Industri A/S in Bangalore for further information and trial samples.

The IJIRA bleach, in which a hypochlorite treatment under nearly neutral conditions (pH 7.5) is used, is also said to be effective. However, there is a danger of chemical damage to the cellulose under such conditions, leading to severe loss in fabric strength. The alleviation of hairiness is itself an indication of fibre strength loss. Careful monitoring, by fluidity or copper number, is essential.

C. Light fastness.

1. Work at IJIRA has shown that removal of lignin from the jute fibre, for example by hypochlorite bleaching followed by an alkaline extraction, leads to an improvement in light fastness; but lignin is a necessary cementing material, and the process can result in a significant reduction in wet strength.

   If the treatment could be limited to the fabric surface, for example by the use of lick-roll or foam application, light fastness might be improved without affecting strength.

2. Light fastness of many direct dyes can be improved by an after-treatment, for example with copper sulphate.

D. Loose fibre.

Yarn treatment in hank form allows loose fibre to be removed as lint. In cheese processing, however, the loose fibre is held within the yarn package. If this is a problem, perhaps a vacuum or compressed air device in the cheese winding unit would be helpful.

V. RECOMMENDATIONS

1. Because of the danger of cellulose degradation in hypochlorite bleaching, especially near the neutral point, this process must be carefully monitored by fluidity measurement or copper number determination.

2. Experiments should be carried out with kiss-roll, foam applicator or other low wet pick-up techniques suitable for applying bleach liquor so as to remove lignin preferentially from the fabric surface. A suitable thickening agent may have to be found for increasing the viscosity of the bleach liquor.

3. Another approach to achieve the same result may be to pre-wet the fabric with water or dilute alkali and apply the hypochlorite bleach liquor wet-on-wet. This process may be difficult to control.

4. In package dyeing, immerse the yarn in hot water prior to the dyeing operation, to ensure complete wetting-out and the removal of trapped air bubbles. This applies particularly to the application of basic dyes, which have a fast rate of strike. Trials along these lines should be made, for example

   - fill the machine with the required amount of water,

   - raise the temperature to 70-75°C.,

- immerse the yarn and circulate the hot water for 10-15 minutes from inside to outside,

- reverse the flow and introduce dye and auxiliaries,

- continue dyeing for 40-60 minutes, reversing the flow every 3-4 minutes.

5. Enquiries will be made by this expert to obtain recommendations from ICI in the U.K. for suitable auxiliaries for dyeing jute with basic dyes.

6. The IJIRA shade card is a very useful guide for the industry, and a second volume to include other dye classes, particularly basic and reactive dyes, should be produced as soon as possible.

7. Efforts should be made to extend the range of dyeings with high light fastness (grade 5 and better). In particular, the programme should include a study of the effects of after-treatments, for example with copper sulphate, on the light fastness of jute dyed with direct dyes.

8. Trials should be carried out to study the effectiveness of enzymes such as cellulase in fabric softening and removal of surface hairs. The "Cellusoft" treatment reported by Novo (Denmark, local office Bangalore) may be useful.

9. It must be made clear to industrial co-operators that full commercialisation of the processes developed by IJIRA will require considerable capital input on their part. A modern dyehouse requires laboratory process control and evaluation facilities, instrumental colour matching and recipe prediction, computerised dyebath control and effluent treatment. Stenters should be installed for final processing of fabric, to ensure dimensional stability, freedom from loose fibre and an attractive handle.

REFERENCE

1. L.O. Asferg and T. Videbaek, International Textile Bulletin (Dyeing/Printing/Finishing), 2/90, pp.5-8

ANNEX I

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

16 January 1991

PROJECT IN THE REPUBLIC OF INDIA

JOB DESCRIPTION
DP/IND/86/037/11-13/B/J13102

POST TITLE	Textile chemist (dyeing, bleaching and finishing)
DURATION	3.2 man-months (split missions)
DATE REQUIRED	1st mission (1.1 m/m): 21.11-23.12.88 2nd mission (1.1 m/m): 04.03-06.04.90 3rd mission (1.0 m/m): Early 1991
DUTY STATION	Calcutta with possible travel in the country.
PURPOSE OF PROJECT	Support of the research and development work carried out by the Indian Jute Industries Research Association (IJIRA) and of its industrial application.

DUTIES

Under the general guidance of the National Project Director (NPD) and the UNIDO Chief Technical Adviser (CTA), the expert will

- make a critical review of bleaching and dyeing methods for jute;

- assist IJIRA staff to improve and develop suitable processes for bleaching, dyeing and finishing jute yarns and fabrics;

- assist IJIRA staff in the use of pressure dyeing equipment for yarn and open-width dyeing of fabric and in the development of processing routes which will help to expand jute's markets;

- participate in at least three seminars/workshops/discussions for

senior management to promote the wider use of coloration methods which will allow jute and jute blends to enter new markets;

- write a full account of the work which has been carried out and make recommendations for future development work.

QUALIFICATION

University degree in Textile chemistry with extensive experience in related R+D work.

LANGUAGE

English

BACKGROUND

India produces about 1.3 million tons of jute fibre annually all of which is converted into jute products. 70 per cent of these are consumed domestically (sacking and hessian, in that order) and the remaining 30 per cent exported (hessian, carpet backing cloth, sacking, in that order).

The prices of jute goods and the quantity exported have been declining since 1980, resulting in reduced export earnings. Both the fibre production and its processing are concentrated in south-east India where over 4 million families are directly dependent on jute for their livelihood.

The competitive position of jute vis-a-vis synthetic substitutes - mainly polypropylene - has been eroded steadily over the years as a result of instability of jute prices and insufficient R+D and marketing efforts on behalf of jute.

The Indian Jute Industries' Research Association (IJIRA) in Calcutta was originally set up as a research department of the Indian Jute Mills Association in 1937. In 1966 it was transformed to a cooperative research association under the auspices of the Council of Scientific and Industrial Research (CSIR). Since 1980 IJIRA has

bee attached to the Ministry of Commerce which finances its operation through a levy collected from the jute industry. The policy-making organ of IJIRA is its Council of Management, comprising representatives of the jute industry, Government and co-opted scientists and the Director of the Institute.

The work programme of IJIRA, relating to the processing of jute focuses on the following main areas:

- improving the processability of lower-grades of jute fibre;

- cost reduction by improving existing processing methods and by developing new ones;

- product development - including jute blends;

- equipment design;

- consultancy services.

While progress has been made in all those areas it is imperative that efforts be intensified and for this IJIRA needs external assistance in terms of expert advice, equipment and fellowship training.