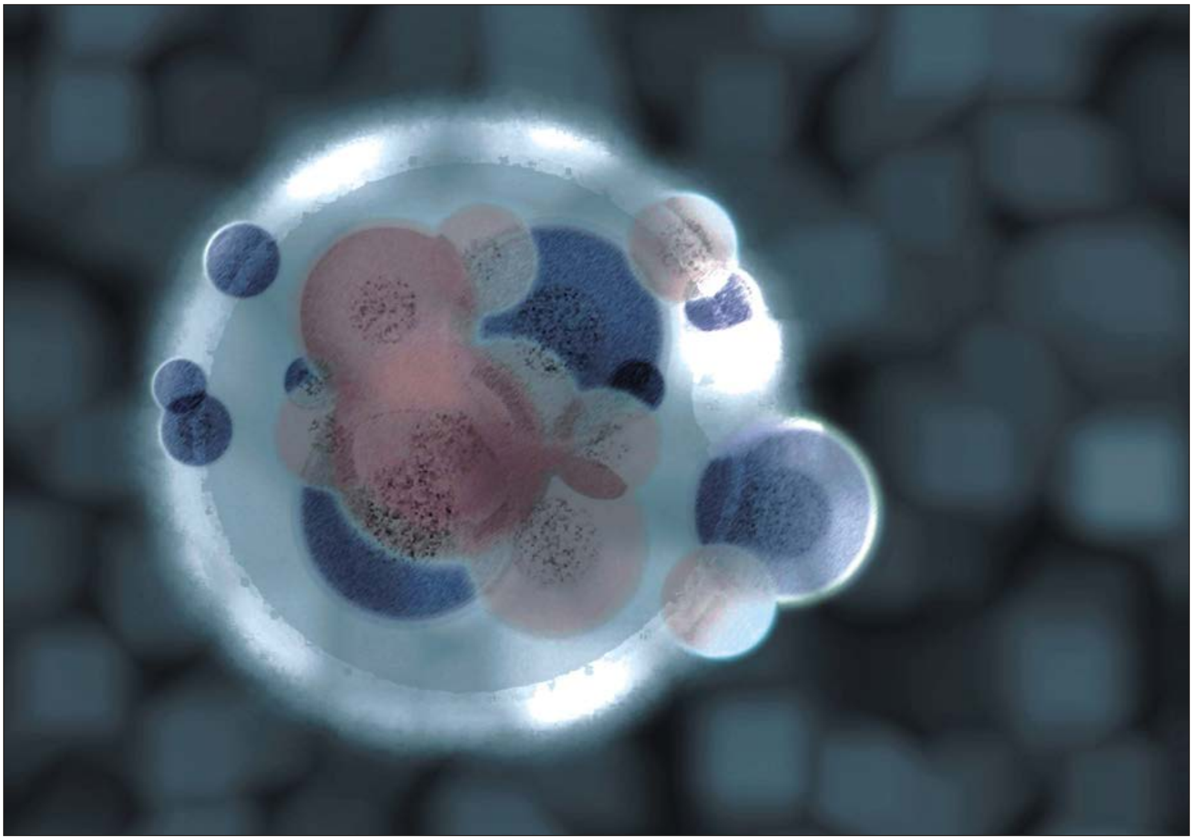

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Physical Properties of Jute Dyed Fabric Crosslinked with DMDHEU

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Abstract: Carpet backing Cloth (CBC), made from *Corchorus olitorius* (Bangla Tossa) fiber was first desized, scoured and bleached with hydrogen peroxide. Simultaneous dyeing and finishing methods were carried out using various reactive dyes with crosslinking agents like dimethylol- hydroxyethyleneurea (DMDHEU) viz. Fixapret CPN, Fixapret ECOs of BASF and Indosol E-50 Powder (Sandoz) along with some catalysts ($MgCl_2$ $6H_2O$) and softening agent employing dry crosslinking method. Various physical properties, such as crease recovery, reduction in moisture content, moisture regain, tensile strength, flexural rigidity and dimensional stability of the crosslinked dyed fabrics were studied. It was found that there exists a direct relationship between resin add-on to the fabrics and significant improvement in dye fixation, crease recovery and reduction in moisture regain. Regarding all dyeing and physical properties Indosol E-50 powder along with various reactive dyes achieved highly satisfactory results. Fixapret CPN may be comparable to Indosol E-50 Powder.

Key words: Carpet Backing Cloth (CBC), crosslinking agents, curing, crosslinking method, reactive dyes, dyeing-finishing, physical properties

INTRODUCTION

Jute is a natural fibre composed of cellulose, lignin, hemicelluloses, waxes, pectin and protein mineral matters (Shahidullah, 2005). Due to inroad of synthetic fibers the conventional use of jute products is declined. Hence it needs diversification. This is why it is essential to make the jute fabrics attractive and cost effective by dyeing and finishing (Kamal, 2005) as well as improving its physical properties. It has been observed that in exhaust dyeing method the colour yield (dye fixation) of some reactive or direct dyes ranges from 60-80%, i.e., upto 40% of dye is lost in course of dyeing (Patro, 1971). But there is little loss in cross lining technique method.

A trifunctional cross linking agent and a mono functional dye can yield high degree of fixation under suitable condition (Lutzel, 1966; Mannul, BASF, 1973).

The cross linking agents containing two or more reactive groups are capable of forming stable chemical bonds with both the cellulose and nucleophlic groups of dye under acidic condition results high color yield (Lutzel, 1966; Trotman, 1984), high colour fastness rating with dimensional stability and crease recovery.

It was observed (Som and Mukherjee, 1989) that the cross linking treatment of jute with DMDHEU made it less hygroscopic.

To evaluate the effect of chemical treatment like pretreatment dyeing and cross linking with DMEU and DMDHEU on fabric properties i.e., tensile strength, crease recovery, wash and light fastness were studied by some workers (Ganguly *et al*., 1989).

Cross linking of bleached jute fabrics with melamine formaldehyde (MF) and $MgCl_2$, $6H_2O$, as catalyst showed significant improvement of crease recovery and reduction in the moisture regain properties of the fabric (Amin *et al*., 1990).

Some workers studied the physical properties of cotton fabrics finished pre-reacted dimethyldimethylol-hydroxyethyleneurea and acrylic acid (DMDMHEUAA). They observed that the wet crease recovery, moisture regain and wicking height valued of the treated fabrics increased with increasing pre-reaction temperature, time, hydrogenperoxide content and acrylic acid content (Chen and Chen, 2001).

Some workers (Kamal *et al*., 2003) studied the dyeing properties including breaking strength of dyed jute fabrics applying padding method with pigment dyes and found insignificant loss in strength of dyed jute fabrics at higher curing temperature.

The present research has been undertaken to study the physical properties of the cross linked dyed fabrics treated with DMDHEU.

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MATERIALS AND METHODS

Carpet Backing Cloth (CBC), made from *Corchorus olitorius* (Bangla Tossa) fiber was first desized, scoured and bleached with hydrogen peroxide (Marsh, 1946; Salam *et al*., 1978). Simultaneous dyeing and finishing methods were carried out using various reactive dyes with crosslinking agents like Fixapret CPN, Fixapret ECOs of BASF and Indosol E-50 Powder (Sandoz) along with some catalysts ($MgCl_2$ $6H_2O$) and softening agent employing dry crosslinking. This study was conducted in the technological research laboratory of Bangladesh Jute Research Institute during the year 2003-2004.

Preparation of cross linking solution with DMDHEU: Padding bath was prepared with the following recipe:

- Procion M-dye: 20 g L^{-1}, Fixapret CPN/Fixapret ECOs (Optimized): 100 g L^{-1}
- Basosot E-UK: 20 g L^{-1}, Citric acid: 5 g L^{-1}, Catalyst ($MgCl_2$ $6H_2O$): 10 g L^{-1}

First of all the procion M dyes were dissolved by pasting with cold water followed by pouring warm water. The required amount of pre dissolved dyes and others dissolved chemicals were mixed together and was made to the required volume and the pH of the solution was adjusted to 4-5.

Application of mixed solution to jute fabrics (Dry cross linking): The prepared mixed solution was poured to the padding bath of two bowl padding machine and bleached CBC was padded (impregnated) through the above formulations to yield a wet pick up 90-100%. The fabrics were then dried, cured at different temperatures like 120, 130, 140, 150, 160°C for 2-3 min in a stenter/heat setting machine, washed with alkali and detergents for 10 min at 75°C in order to remove the unfixed dyes. In brief the sequence of operation was as follows:

Padding > drying > curing > washing >

Application of indosol E-50 powder with reactive dyes: The impregnation bath was prepared by mainly the following recipe.

A) Procion M dye : 20 g L^{-1} B) Indosol E-50 powder : 40 g L^{-1} (Optimized)
Catalyst : 10 g L^{-1}, Basosoft EUK : 20 g L^{-1}, Acetic acid : 3 g L^{-1}

Sequences of operation

- Padding ('A' solution), Padding ('B' solution), drying and curing
- Padded the fabric with above mixed solution to give liquor pick up 100%, dried and cured the faric at 140-160°C for 2-3 min.

Testing: All physical properties were determined by standard methods.

RESULTS AND DISCUSSION

The physical properties such as, resiliency in terms of crease recovery angle, moisture content, moisture regain, tensile strength, flexural rigidity and dimensional stability of the Crosslinked dyed fabrics were determined by standard methods as shown in the Table 1.

The cross linking technique improved fabric resilience to a great extent (38-53%). The most effect means of this improving fabric resilience is perhaps firstly, by reacting fiber with cross linking agent (DMDHEU) that is able to fix the position of molecules and secondly, when acid reacts with cellulose there is a reduction in chain length by hydrolysis of 1, 4 oxygen bridges between glucose units. The fabrics containing this property are suitable for furnishing purposes.

The decreasing tendency of moisture absorbing affinity with increasing resin (Fig. 1) added-on is due to the blockage of the hydroxyl groups of jute cellulose by cross linking system.

It appears from the Fig. 2 that the strength of all kind of cross-linked dyed jute fabrics decreases with increase of curing temperature. This was due to the embrittlement of cellulose during curing at higher temperature.

In Fig. 3 the stiffness developed therein may be due to some polymer disposition in and between the fibres and the yarns of the fabrics cross linking occurred between the jute cellulose macromolecule, nucleophilic

Table 1: Crease recovery (DCR) angle of cross-linked dyed fabric at different curing temperatures

Name of cross-linking agent used	DCR at different temperatures (°C)					
	Original	120°C	130°C	140°C	150°C	160°C
Fixapret CPN	65	80	85	89	95	100
Indosol E-50 powder	65	80	85	90	91	90
Fixapret ECOs	65	82	83	89	95	94

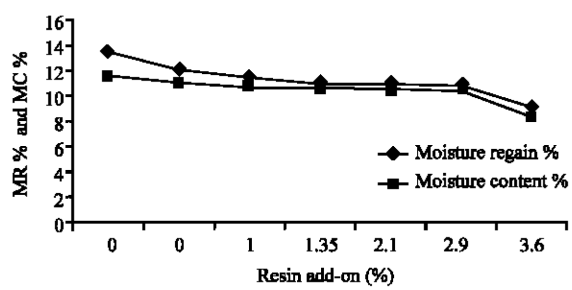

Fig. 1: Effect of Cross-linking agent (Resin) on MR% and MC%

Table 2: Dimensional changes of cross linked dyed fabrics

	Length before Crosslinking (cm)		Length after crosslinkg (cm)		Shrinkage (%)	
Description of samples	Warp	Weft	Warp	Weft	Warp	Weft
Exhaust dye fabrics (not crosslinked)	147	28	140	26	4.76	7.14
Crosslinked dyed fabrics with 1% resin add-on	146	28.5	144	28.0	0.68	1.75
Dyed fabric with 1.35% resin add-on	147	28.0	145.5	27.5	1.02	1.78
Dyed fabric with 2.1% resin add-on	146	29.0	145.0	28.5	0.68	1.72
Dyed fabric with 2.9% resin add-on	146	27.0	145.0	25.5	0.68	1.85
Dyed fabric with 3.6% resin add-on	147	26.0	145.5	25.5	1.02	1.92

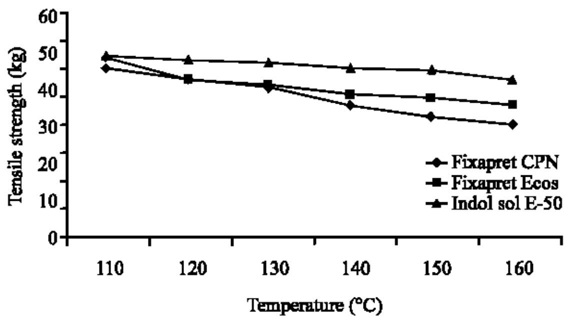

Fig. 2: Effect of cross-linking agent on tensile strength at different curing temperature

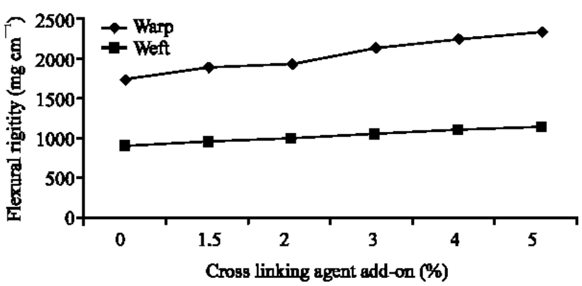

Fig. 3: Effect of Cross-linking agent on Flexural rigidity

group of dye and precondenate. Hence it may be inferred that both crosslinking and polymer deposition are simultaneously occurring within the fabrics.

The anti-shrinkage behavior of cross-linked dyed fabric (Table 2) compared to fabric dyed by exhaust dyeing method may be explained that the resin has either formed some sort of crosslinking between the far apart hydroxyl groups of amorphous regions of cellulose or filled up the intra molecular spaces therein. Hence, the jute fabrics in the amorphous regions have been oriented orderly giving some compactness like that of crystalline region and this has ultimately led to develop anti shrinkage or anti elongation properties in the cross-linked fabric.

It appears that the bleached jute fabrics (CBC) dyed and finished simultaneously with various dyes and Indosol E-50 powder (Sandoz) applying pad-dry-cure method showed excellent performance in respect of all dyeing properties. Fixapret CPN (DMDHEU) of BASF achieved almost satisfactory results, whereas Fixapret ECOs attained unexpected results except in the case of crease recovery, because it did not react with dyes.

The crosslinking technique improved fabric resiliency to a great extent (more than 50%) and improved fabric qualities with a higher flexural rigidity and it increased crease resistance, reduced moisture regain properties, which are proportional to the level of applied resin. The crosslinked dyed fabrics, may be used as furnishing fabrics, wall coverings, upholstery, curtain etc.

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