

Development of Water Repellency on Jute Fabric by Chemical Means for Diverse Textile Uses

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Abstract

Jute is one of the natural cellulosic textile materials. It has many advantageous properties similar to cotton. Jute fibre has potential to impart different functionality by different chemical finishing for its diversification. In this research, Water repellent jute fabrics have been prepared by treating Nova TTC (fluorocarbon compound) different ratio and to find out the best formulation recipe. Treating fabrics have been impaired with a water repellent characteristic and showing good rating result on jute fabric. This water repellent fabric was suitable of various jute products for diverse textile uses.

Keywords: Water repellency, jute fabric, Fluorocarbon, functionality, Water repellent finish.

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INTRODUCTION

Jute is lignocelluloses, biodegradable natural and environment friendly fibre [1]. It is a long golden colour natural fiber is second only to cotton in amount produce and variety of uses of natural fibers. It is composed of mainly cellulose, hemicellulose and lignin [2]. Cellulose substrate has always been excellent for many applications such as textile garments and packaging materials for food industry. However, unmodified substrates absorb and lose moisture easily [3], especially those designed to be used outdoor which expose to a combination of physical and chemical degradation processes due to the combined effects of sunlight, moisture, fungi, bacteria, etc. [4]. The manufacturing process in the jute industry goes through various activities including raw jute cultivation, jute fiber processing, spinning, weaving, bleaching, dyeing, finishing and marketing of both raw jute and its by-products. Jute bags are mainly used for packing cement, sand, agricultural products, sugar and other heavy items. These bags are ideal for transporting bulk food items like onion, potato, flour, rice and fertilizer. Jute bags have a major problem of high water absorption which spoils its contents. Water repellent is defined as the ability of a textile material to withstand moisture. The tendency of water droplets to spread on the fabric

surface mainly depends on the water droplets and the angle of contact of the fabric surface. The water resistant textile industry has many uses, including for consumer and clothing purposes. This resistance can be achieved by applying a thin surface layer of water resistant chemicals to the textile fibers. Water repellency can be done by the modification of surface energy of textiles with minimal effects on other functional properties like strength, flexibility, breathability, softness etc [5, 6]. Chemical modification is one of the routes for altering properties of natural polymeric materials. Water repellency may be added by treating the fabric with aluminium (Al) and zirconium (Zr) compounds, paraffin emulsion, fluorocarbon based chemicals, silicon compounds, N-methylol compounds, stearic acid-melamine compounds or metal complexes [7]. At present the common water repellent agents are polydimethylsiloxane, silica [8, 9] and fluorine containing agents [10]. Which are chemically incorporated on fibre surfaces [11]. There has been a market increase in the commercial use of fluorochemicals in recent years, particularly to impart water repellency to cotton. It has been reported that various types of fluorochemicals that are used for textile finishing, mainly used to impart water repellency along with oil repellency [12-17]. Water repellency has been one of the major targets for fibre and textile scientists

and manufacturers for centuries. In the research, Some of researches on different water repellent chemicals, their application procedure, curing temperature, their durability and different wash fastness have been evaluated [18, 19]. Water repellent textiles, by definition, repel water from the surface of the fabric. When functionalizing a fabric for water repellency, it is important to keep in mind the end use of the textile. The purpose of this study was to evaluate effectiveness of water resistance in the properties of jute fabric after finishing.

MATERIALS AND METHODS

Materials

A plain weaved jute fabric (20 end/inch and 16 pics /inch) was collected from the local market, Bangladesh. Jute fabric commonly known as a hessian cloth with mass per unit area of 265g/m² was fabricated for the research.

Chemicals

Nova TTC (Trade name), Sodium carbonate, Sodium Hydroxide, wetting agent, Acetic acid, Lissapol was purchased from local market in Bangladesh. All chemicals were reagent grade.

In this experiment, we used different types of machine. These are Digital electronic Balance, P^H meter, Padding machine, Laboratory stenter machine, water bath, Different glassware, Tensile strength tester, Jigger machine and auxiliaries etc. Padding machine (2b/press) was used for uniform distribution of proofing ingredients in the fabric.

Heat setting machine was used for drying and heat setting purpose. It was then calendered and hot pressed to achieve better stiffing along with smooth finishing effect.

Experimental procedure

Scouring: To remove the dirt, wax, oil, and fatty acids from the fabric. Firstly the fabric was treated by scouring in solution containing 3% sodium carbonate, 1% sodium hydroxide, 1% wetting agent at 80⁰-90⁰C in bath for one hour bearing liquor ratio 1:20.I

was then washed with water and dry ambient temperature [20, 21].

After scouring jute fabric sample were treated with water repellent chemicals by exhaust method as per the following conditions : 0-1ml/l acetic acid 50%,40%,30% concentrations of Nova TTC liq. Exhaust time 15 minutes, liquor ratio 1:10. Then the sample was padded by padding machine cure for 2 minutes at 150⁰C and 140⁰c.

Liquor pick-up: The liquor pick up was determined each of the samples. The liquor pick up of the treatment process was determined by weight samples before and after padding according to the following formula.

Liquor pick up = (weight of sample after padding- weight of sample before padding) X 100/ weight of sample before padding.

Tensile strength: The tensile strength of the treated samples was measured by the standard method. Room temperature maintained as follows: Temp= 20⁰±2⁰C, Humidity=65% ± 2%.

Storage test: Effect of storage on the water repellence and tensile strength of the treatment fabrics were observed up to six months.

Water repellent test: The sample was tested in the standard atmosphere, 25±2⁰C temperature and 65% ± 2% RH after conditioning 24 hrs. There are three types of water repellent tests were used.

- 1) Absorbency test
- 2) Drop test
- 3) Spray rating test (AATCC 22-2001 test method is used to evaluate the water repellency of the fabric. Spray rating tests were done by Spray Rating Tester.

Spray Test

The waterproofing agent is assessed visually in the following manner:

Table-1: Determination of the repellence property of jute fabric by the using of spray test

AATCC Spray Rating	
Rating	Description
100	No wetting of the surface
90	Very slight wetting of the surface
80	Wetting where droplets impact on the surface
70	Partial wetting of whole surface
50	Complete wetting of the upper surface
00	Complete wetting of the upper surface and lower surfaces of the specimen.

RESULT AND DISCUSSION

Water Repellency Test

1) Absorbency test (Spot test)

In a pipette a solution of 1% direct proceion yellow was taken and droplet of solution was put on the different places of the fabric. The shape of the absorption area on the fabric was observed from below Fig 1. (a) For the scoured jute fabric sample, an outline of the droplet were observed indicates absorption .In the absense of water repellent treatment, the drops get absorbed and spread on the surface of the fabric. Fig1. (b) For only jute fabric and water repellent finished, the water droplet do not spread or get absorbed by the surface. In the photograph the water drop can't seen. This confirms the water repellent treatment was successful.



Fig-1(a)



Fig-1(b)

2) Drop test

This is the visual test to evaluate the water repellency. If the material has lower surface tension than water, then that material is called water repellent. When a water droplet is placed on water repellent material then the drop will rest up

On it and will not penetrate. Here are some physical appearances of untreated and treated jute fabrics, showed that treated fabrics are water repellent.

Some physical appearance of water droplet on untreated and treated fabric:



Untreated fabric



Treated fabric

- 3) Spray ratting of jute fabric with water repellent chemicals at 30 g/l, 40 g/l, 50 g/l.conc.at 140⁰c and 150⁰c curing temperature.

Sample no.	Conc.(g/l)	Chemicals	Curing temperature	
			140 ⁰ C	150 ⁰ C
01	30 g/l	Nova TTC	80	80
02	40 g/l	Nova TTC	90	100
03	50 g/l	Nova TTC	100	100

It was found that the treatment (samples 1, 2 and 3) could provide the desired water resistance properties for jute fabrics. In this sample, sample 3 was very effective for water resistance without any unwanted loss of fabric strength.

CONCLUSION

The treated fabrics have provided water resistant properties, reaching value of 80, 90,100 for jute fabrics respectively. The treated fabric can be used in rain wear, upholstery for sports automobile headliners, cover tape for adhesive plaster and for outdoor activities. The water repellency of jute may be improved with the help of nano technology.

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