Carbohydrate Polymers 82 (2010) 1198–1204

Contents lists available at ScienceDirect

Carbohydrate Polymers

journal homepage: www.elsevier.com/locate/carbpol

Innovative multi-functional treatments of ligno-cellulosic jute fabric

N.A. Ibrahim*, A. Amr, B.M. Eid, Z.M. El-Sayed

Textile Research Div., NRC, Dokki, Cairo, Egypt

ARTICLE INFO

Article history:
Received 2 June 2010
Received in revised form 16 June 2010
Accepted 25 June 2010
Available online 27 July 2010

Keywords:
Jute
Finishing
Combined finishing and dyeing
Functional properties
Added-value

ABSTRACT

This study is focused on upgrading the functional and dyeing properties of jute, an eco-friendly cellulose-rich ligno-cellulosic fiber, for its further application in diversified and value added products. Grey Jute fabric has been scoured, bleached then post-finished in absence and presence of disperse and basic dyes for imparting easy care, water repellency, a supple handle as well as UV-protecting properties into the finished and finished/dyed Jute fabrics. Factors affecting the functional and dyeing properties such as pretreatment regime, water repellent and finishing agents concentration, finishing in the absence and presence of the nominated dyestuffs as well as durability to wash have been studied. The results demonstrate that increasing the water-repellent agent, Hydrophobol® APK, concentration up to 75 g/L, finishing agent, Fixapret® Eco, concentration up to 50 g/L, using $MgCl_2 \cdot 6H_2O$/citric acid as a mixed catalyst (5 g/2 g)/L, in the absence or presence of the dye (5 g/L) followed by drying at 100 °C/5 min, curing at 150 °C/min, then after washing, is accompanied by a significant enhancement in both the imparted functional and dyeing properties of the treated jute fabrics. The extent of improvement of the aforementioned properties is determined by the pretreatment sequence, i.e. scouring alone or followed by bleaching. The imparted functional properties show some reduction after five home launderings. SEM of untreated, scoured and semi-bleached then finished or finished/dyed fabric samples as well as the fastness properties of the obtained dyeings were also investigated.

© 2010 Elsevier Ltd. All rights reserved.

1. Introduction

The renewed demand for Jute, cellulose-rich ligno-cellulosic fiber, is mainly attributed to its eco-friendly, biodegradable and hydrophilic nature, renewability, low cost, and diversified outdoor, e.g. outer garments, curtains, tents, etc., and indoor-applications, e.g. upholstery, furnishing, wall hanging, etc., along with its traditional products such as ropes, cords, sacking, carpet backing cloth, etc. (Chattopadhyay, Pan, Roy, & Khan, 2009; Pan, Chattopadhyay, & Day, 2007).

The main chemical components of Jute fiber are cellulose (58–63%), hemicelluloses (20–24%) and lignin (12–15%) along with some other small amounts of constituents like protein (2%), mineral matters (1%), pectin, aqueous extract, etc. (Pan, Day, & Mahalanabis, 1999). Many studies have been done to develop Jute processing as well as to upgrade the quality, coloration and performance properties of Jute-based textiles to be more attractive, cost-effective and eco-friendly (Pan, Chattopadhyay, & Day, 1996; Chattopadhyay et al., 2009; Chattopadhyay, Pan, & Day, 2004; Ghosh & Das, 2000; Ibrahim, El-Gammal, Hassan, & Hussein, 2009; Pan et al., 1999, 2007; Salam, 2006; Samanta, Singhee, Basu, & Mahalanabis, 2007; Shahidullah, Uddin, Sayeed, Shahinur, & Ahmed, 2009; Uddin et al., 2007; Wang, Cai, & Yu, 2008)

In this study, a novel attempt has been done to study the technical feasibility of combined functional finishing and dyeing of Jute fabric for attaining non-traditional and high value added products.

2. Experimental

2.1. Materials

Plain weave 100% Jute fabric (262 g/m^2) was used as a starting grey fabric. Fixapret® ECO (low-formaldehyde crosslinker, BASF), Hydrophobol® APK (cationic, water repellent finish, based on paraffin wax emulsion containing aluminum salt, Ciba), and Hostapal® 3634 (nonionic wetting agent based on alkylaryl polyglycol ether, Clariant) were of commercial grade.

Disperse violet 1, disperse red 60, and basic red 18 were kindly supplied by DyStar whereas basic violet 16 was kindly supplied by Bayer.

All other chemicals used during this study were laboratory grades. Types and amounts are given in the methods section.

2.2. Methods

2.2.1. Scouring

Scouring of the Jute fabric was performed using a solution containing sodium hydroxide (10 g/L) and a nonionic wetting agent

* Corresponding author.
E-mail addresses: nabibrahim-49@yahoo.co.uk, nabibrahim@hotmail.com (N.A. Ibrahim).

0144-8617/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.carbpol.2010.06.055

(2 g/L) at 95 °C for 60 min, with a material-to-liquor (LR) ratio of 1:10, whereafter, the fabric washed thoroughly in hot water and cold water, neutralized with acetic acid (2 mL/L), and followed by washing and air drying.

2.2.2. H_2O_2-bleaching

Bleaching of the scoured-Jute fabric was performed in aqueous solution containing H_2O_2 (5 or 10 g/L, 35%), soda ash (2 g/L), sodium silicate (5 g/L), tri-sodium phosphate (5 g/L), and nonionic wetting agent (2 g/L) for 90 min at 95 °C with a material-to-liquor ration of 1:10. After bleaching, the fabric was washed, neutralized with acetic acid (2 g/L), washed again, and dried.

2.2.3. Multi-functional finish

In a true, single-bath process, Jute fabric samples were padded twice with the reactant resin, Fixapret® ECO (0–100 g/L), water repellent, Hydrophobol® APK (0–100 g/L), $MgCl_2{\cdot}6H_2O$ (1% ow. Fixapret®), citric acid (2 g/L) and nonionic wetting agent (2 g/L) to a 80% wet pick up, followed by drying at 100 °C for 5 min, curing at 150 °C for 3 min, and after washing to remove unreacted/unfixed reactants.

2.2.4. Combined dyeing and functional finishing

Dyeing and finishing was carried out simultaneous according to the following sequence: padding → drying → curing → washing. Padding bath was prepared with Fixapret® ECO (75 g/L), Hydrophobol® APK (75 g/L), $MgCl_2{\cdot}6H_2O$ (7.5 g/L), citric acid (2 g/L), nonionic wetting agent (2 g/L), along with the disperse or basic dye (5 g/L). Jute fabric samples were padded twice through the above mentioned formulations to a 80% wet pick up, followed by drying at 100 °C for 5 min and curing at 150 °C for 3 min, thoroughly washed with cold water, soaped in 2 g/L nonionic detergent at 45 °C for 15 min, to remove the unfixed reactants and/or dyes, again thoroughly washed and dried at 100 °C for 5 min.

2.2.5. Testing

Nitrogen content was determined using micro-Kehjeldal method. Dry wrinkle recovery angle (WRA) was evaluated using the iron recovery apparatus (type FF-07Metrinpex®). Water-repellency rating was evaluated according to AATCC 22-1980 spray test method. Roughness of the treated and untreated samples was measured according to JIS94 standard by using SE 1700α instrument, Japan. Yellowness index was evaluated by using Color-Eye® 3100 Spectrophotometer supplied by SDL Inter, England according to the Standard Test Method ASTM E-313. Color strength, K/S, of the obtained dyeings were measured and evaluated, at the λ_{max} of the dye, using the Color-Eye 3100® Spectrophotometer using the Kubelka–Munk equation: $K/S = (1 - R)^2/2R$ (where K: absorption coefficient, S: scattering coefficient, R: reflectance). UV-protection factor, UPF, was determined according to the Australian/New Zealand Standard (AS/NZ 4399-1996). Scanning electron micrographs, SEM's, of untreated and treated Jute fabric samples were taken using a scanning electron microscope JEAOL JXA-840A. Prior to SEM investigation, the samples were coated with gold using a SIS0A sputter coat unit Edward, UK. All the dyed/finished fabric samples were subjected to wash and light fastness tests according to the AATCC Test Methods (61-1972) and (16A-1971), respectively. All the determinations in this study were performed in triplicate and the results represent mean values with less than 0.2% of error. Durability of the imparted functional properties was evaluated, up to 5 launderings according to AATCC test method 124-1975.

3. Results and discussion

3.1. Hydrophobol® APK concentration

In order to obtain the optimum hydrophobic agent concentration for imparting water repellent property, the scoured Jute fabric samples were treated with different Hydrophobol® APK concentration from 0 to 100 g/L along with Fixapret® ECO (50 g/L) as a crosslinking agent and $MgCl_2{\cdot}6H_2O$ (5 g/L)/citric acid (2 g/L), as a mixed catalyst, nonionic wetting agent (2 g/L), to a 80% wet-pick up, followed by drying at 100 °C/5 min and curing at 150 °C/3 min. After the treatment, the nitrogen content (%N), water repellency rating (WRR), roughness and wrinkle recovery angle (WRA), were evaluated. The results are presented in Fig. 1a and b.

As is evident, Fig. 1a, increasing the water repellent agent concentration up to 75 g/L results in a significant increase in the water-repellency rating from 0 up to 80 along with a gradual slight decrease in the nitrogen content of the treated fabric samples. Further increase in the Hydrophobol® APK concentration has no effect on water repellency rating with a marginal decrease in the nitrogen content. On the other hand, Fig. 1b shows that increasing

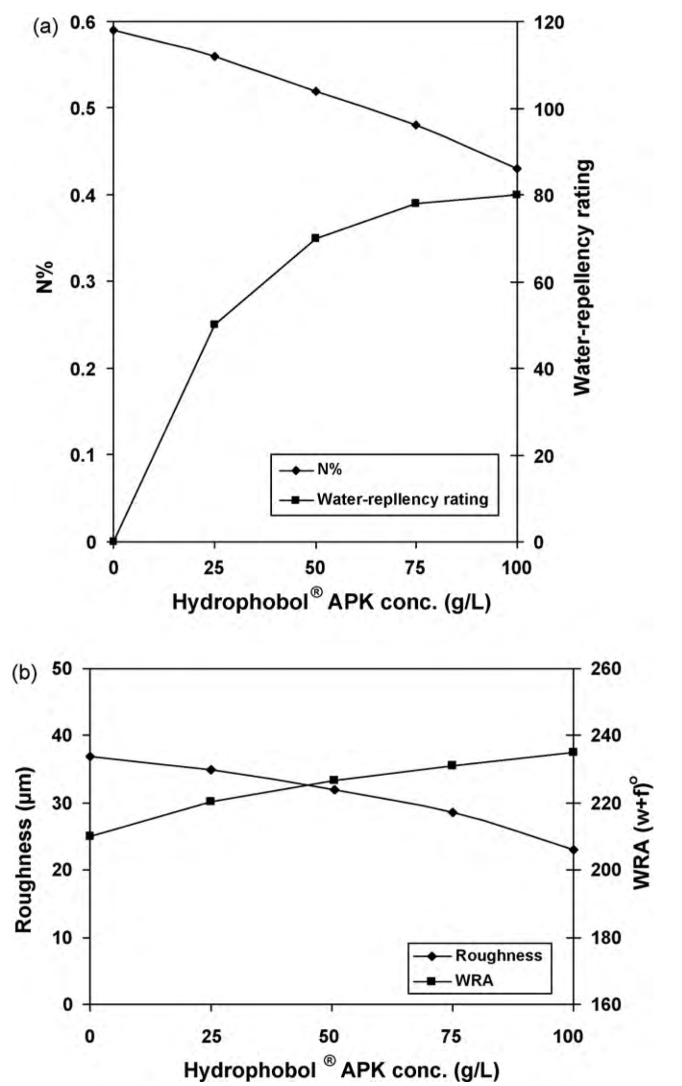

Fig. 1. Effect of Hydrophobol® APK concentration on nitrogen content and water repellency rating (a), and on roughness and wrinkle recovery angle (b) of treated jute fabric samples. Substrate: scoured jute, Fixapret® ECO (50 g/L), $MgCl_2{\cdot}6H_2O$ (5 g/L), citric acid (2 g/L), nonionic wetting agent (2 g/L), wet-pickup (80%), drying at 100 °C, curing at 150 °C/5 min, followed by afterwashing.

Download English Version:

https://daneshyari.com/en/article/1383918

Download Persian Version:

https://daneshyari.com/article/1383918

Daneshyari.com