Carbohydrate Polymers 119 (2015) 182–193

Contents lists available at ScienceDirect

Carbohydrate Polymers

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

New finishing possibilities for producing durable multifunctional cotton/wool and viscose/wool blended fabrics

N.A. Ibrahim[a,*], M.R. El-Zairy[b], B.M. Eid[a], E.M.R. El-Zairy[b], E.M. Emam[b]

[a] Textile Research Division, National Research Center, Cairo, Egypt
[b] Faculty of Applied Arts, Printing, Dyeing and Finishing Department, Helwan University, Cairo, Egypt

ARTICLE INFO

Article history:
Received 5 September 2014
Received in revised form
17 November 2014
Accepted 18 November 2014
Available online 26 November 2014

Keywords:
Cellulose/wool blend
Multifunctional finish
Easy care
Soft-hand
Antibacterial
Anti-UV

ABSTRACT

This research work focuses on the development of a one-bath functional finishing procedure for imparting durable multifunctional properties such as easy care, soft-hand, antibacterial and/or ultra violet (UV) protection to cotton/wool and viscose/wool blends using diverse finishing combinations and formulations. In this study finishing agents such as reactant resin, silicon softeners, 4-hydroxybenzophenone, triclosan, and pigment colorant were selected using magnesium chloride/citric acid as a mixed catalyst and the pad-dry microwave fixation technique. The results reveal that enhancement in the imparted functional properties are governed by type of the finished substrate as well as nature and concentration of finishing formulation components. The finished fabrics still retained high level of functionalities even after 15 consecutive laundering. Surface morphology and composition of selected samples were investigated using scan electron microscope (SEM) and energy-dispersive X-ray spectroscopy (EDX) analysis. The mode of interactions was also investigated. Practical applications for multifunctionlization of cellulose/wool blended fabrics are possible using these sorts of proper finishing formulations and unique finishing application method.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

Cellulose is the most abundant natural biopolymer composed of β-D-glucopyranose units linked together by β-1-4-linkage. Each unit bears three accessible hydroxyl groups at C_2, C_3 and C_6 sites. Its degree of polymerization depends on its source as well as processing stages. Textile materials based on cellulosic fibres can either obtained from respective plants such as cotton, flax, jute, ramie, sisal or by dissolution and regeneration of cellulosic materials like viscose rayon and Tencel (Buschle-Diller, 2003).

Recently, there has been a great interest in modifying the surface, mechanical, physical, chemical and/or functional properties of cellulosic materials to correct their defects, to improve their inherent properties, and to add or impart new functional properties for attaining an eco-friendly/biodegradable/low cost/high performance functionalized new materials for various potential applications such as reinforcement materials, bionanocomposites, hydrogels, green composites as well as functionalized textile materials (Holme, 2007; Chang & Zhang, 2011; Siqueria, Bras, & Dufresne, 2010; Thakur, Thakur, & Gupta, 2014a; Thakur, Thakur, & Gupta, 2014b; Thakur, Thakur, Gupta, & Kumar, 2014c; Thakur, Thakur, & Gupta, 2013; Zimniewska, Wladyka-Przybylak, & Mankowski, 2011).

On the other hand, The increase in global population, in natural and/or synthetic fibres consumption as well as in global competition in apparel, interior, home and technical textiles, taking in consideration the environmental, economic and quality dimensions, has intensified R&D efforts and generated many opportunities for utilization of emerging technologies and application of innovative functional finishes for developing and producing innovative/durable/cost-effective textile products (Holme, 2007; Lam, Kan, & Yuen, 2012; Powel & Cassill, 2006; Sawhney et al., 2008).

Lots of work have been done in functionalization of natural fibres, based on cellulose and/or protein, has received a great attention to impart new properties such as easy care, softness, antibacterial, UV-protection, self-cleaning, and/or water/oil repellency to treated textiles to cope with the changing lifestyles, to provide textile-users with highest levels of comfort, protection, safety and aesthetics and to compete in the tough global market place (Bajaj, 2002; Gouda & Ibrahim, 2008; Hashem & Ibrahim, 2008; Ibrahim, Gouda, & Zairy, 2008a; Ibrahim, Abo-Shosha, Fahmy, El-Sayed, & Hebeish, 2008b; Ibrahim, Amr, Eid, & El-sayed, 2010a;

* Corresponding author. Tel.: +20 1001913084; fax: +20 2 333 70931.
E-mail addresses: nabibrahim49@yahoo.co.uk, nabibrahim@hotmail.com (N.A. Ibrahim).

http://dx.doi.org/10.1016/j.carbpol.2014.11.040
0144-8617/© 2014 Elsevier Ltd. All rights reserved.

Ibrahim, Refai, & Ahmed, 2010b; Ibrahim, Khalifa, El-Hossamy, & Tawfik, 2010c; Ibrahim, Amr, Eid, Mohammed, & Fahmy, 2012a; Ibrahim, Eid, & El-Batal, 2012b; Ibrahim, Gouda, Husseiny Sh, El-Gamm, & Mahrous, 2009; Ibrahim et al., 2013a; Liu, Wang, & Fan, 2012; Perumalraj, 2012; Radetic, 2013; Sivakumar, Murugan, & Sundaresan, 2012).

However a very limited number of publications are available on functional finishing, and simultaneous functionalization and coloration of cellulose/wool blended fabrics (Chikkodi, Khan, & Mehta, 1995; Haggag & Ibrahim, 1991; Harper & Mehta, 1985; Ibrahim et al., 2008a; Ibrahim, Khalil, El-Zairy, & Abdalla, 2013b; Ibrahim, El-Zairy, Abdalla, & Khalil, 2013c; Mehta, 1973).

Accordingly, the present research work is directed towards searching for proper finishing formulations for functionalization of cotton or viscose/wool blends to impart multifunctional properties to the finished fabrics and to extend their potential applications.

2. Experimental

2.1. Materials

Mill-scoured and bleached cotton/wool (50/50, 230 g/m^2) and viscose/wool (50/50, 190 g/m^2) blended fabrics were used.

Arkofix® NDF liq. C (low content of free formaldehyde, based on modified *N*-methyloldihydroxyethylene urea, DMDHEU, Clariant), Tinosan®CEl (encapsulated organic antimicrobial agent based on triclosan, Ciba), GB stain® Repellent FC (hydrophobic, oleophobic and dirt-repellent fluorocarbon compound, BASF), Solusoft® TOW Liquid C (hydrophophilic silicone nano emulsion, weakly cationic, Clariant), Silastol® NSI (nonionic silicon elastomer, Schill & Seilacher), Precosoft® SM 40 (nonionic softener based on amino-polysiloxane micro emulsion, Schill & Seilacher), Zylon® NFL (nonionic softener, based on fatty acid glycol, Rossarl), Printofix® Binder MTB01 EG (APEO-free binder based on acrylate based copolymer, Egcodar), Pigment Red KBN 11009, Pigment Yellow M2GPR12001, Pigment Navy 8309, as well as Hostapal® CVL-ET (nonionic wetting agent based on alkyl aryl polyglycol ether, Clariant) were of commercial grade.

Magnesium chloride hexahydrate ($MgCl_2{\cdot}6H_2O$), citric acid and 4-hydroxybenzophenone (4-HBP) were of reagent grade (Aldrich).

2.2. Methods

2.2.1. Easy care/soft-finish general procedure

The blended fabric samples were padded twice to wet pick up of 80% with an aqueous finishing formulation containing DMDHEU (50 g/L) as crosslinker, ($MgCl_2{\cdot}6H_2O$)/citric acid (8/2 g/L), as a mixed catalyst, in the absence and presence of the softening agent (0–30 g/L) along with 2 g/L nonionic wetting agent, followed by drying and microwave fixation at output of 1300 W for 4 min.

2.2.2. Easy care/soft/antibacterial finish general procedure

To impart multifunctional properties to the nominated substrates, the blended fabric samples were padded twice in a single bath containing: DMDHEU (50 g/L), ($MgCl_2{\cdot}6H_2O$)/citric acid (8/2 g/L), softener (20 g/L), antibacterial agent, Tinosan® CEL (0–30 g/L) along with a nonionic wetting agent (2 g/L), to give wet pick up of 80%, followed by microwave fixation as mentioned before.

2.2.3. Easy care/soft/water/oil repellency finish general procedure

Blended fabric samples were padded twice in a multifunctional formulation containing: DMDHEU (50 g/L), ($MgCl_2{\cdot}6H_2O$)/citric acid (8/2 g/L), softener (20 g/L), and water/oil repellent agent (0–150 g/L) to a wet pick up 80%, followed by microwave fixation as mentioned in Section 2.2.1.

2.2.4. Easy care/soft/UV-protection finish general procedure

Cotton/wool and viscose/wool blended fabric samples were padded twice in a single-bath containing: DMDHEU (50 g/L), ($MgCl_2{\cdot}6H_2O$)/citric acid (8/2 g/L), softener (20 g/L), UV-absorbing agent (0–10 g/L) along with a nonionic wetting agent (2 g/L) to a wet pick up 80%, followed by microwave fixation as given in Section 2.2.1.

2.2.5. Multifunctional finishing/pigment dyeing in one step general procedure

Blended fabric samples were padded twice, to a wet pick up of 80%, in a finishing/dyeing formulation including: DMDHEM (50 g/L), ($MgCl_2{\cdot}6H_2O$)/citric acid (8/2 g/L), softener (20 g/L), binding agent (100 g/L), pigment colorant (20 g/L) and a nonionic wetting agent (2 g/L), followed by microwave fixation at 1300 W/4 min. The coloured/finished specimens were then washed at 50 °C/15 min, thoroughly rinsed in tap water at 25 °C, and then dried in ambient air.

2.2.6. Measurements

The nitrogen content, expressed as %*N*, was determined according to Kjeldhal method.

Colour strength of the obtained dyeings, expressed as *K*/*S* values, was calculated from reflectance data using Kubelka–Munk equation (Judd & Wyszeck, 1975):

$$\frac{K}{S} = \frac{(1-R)^2}{2R}$$

where *K* and *S* are the absorption and scattering coefficient respectively, and *R* is the reflectance at wavelength of maximum absorbance of the used pigment colorants.

Fastness properties to washing, rubbing and light were evaluated according to AATCC test methods: (61-1972), (8-1972), and (16A-1972), respectively.

Surface roughness, arithmetic average roughness (*Ra*), of the treated and unfinished fabric samples was evaluated according to JIS B 0031-1994 Standard, analyzed in an automated roughness tester (Surfcorder SE 1700; Kosaka Laboratory Ltd, Kosaka, Japan). When the roughness curve is represented by $y = f(x)$, *Ra* is the value in microns (μm) found from the formula:

$$Ra = \frac{1}{e}\int_0^{\ell} |f(x)|\mathrm{d}x$$

where l: reference length.

Dry wrinkle recovery angle (WRA) was evaluated according to ASTM Method D-1296-98.

Antibacterial efficacy of functionalized fabric samples against G +ve (*S.* aureus) and G −ve (*Escherichia coli*) bacteria was assessed using agar diffusion test according to AATCC test method 147-1988.

UV-protection factor (UPF) was calculated according to the Australian/New Zealand standard (AS/NZS 4366-1996).

Water repellency (WRR) and oil repellency rating (ORR) were performed using the spray test method 22-1989 and AATCC test method 118-2007.

The durability to wash was evaluated after 15 laundering cycles according to AATCC test method 135-2000.

Scanning electron microscope (SEM) images of selected samples were evaluated using a JEOL, JXA-840A electron probe microanalyzer equipped with disperse X-ray spectroscopy (EDX) for the composition analysis.

Download English Version:

https://daneshyari.com/en/article/1383791

Download Persian Version:

https://daneshyari.com/article/1383791

Daneshyari.com