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Surface modification of acid activated polyamide fiber by immobilizing collagen

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Keywords: Polyamide fiber, Surface modification, Collagen, Immobilization.

Abstract. Collagen was immobilized onto moderate acid activated polyamide fibers with glutaraldehyde (cross-linking agent) aimed to improve its sanitary property. The immobilization of collagen onto polyamide fiber was estimated by dyeing collagen modified fabrics with a cationic brilliant red 5GN, and determining the dyeing properties of the dyed fabrics. The modification also confirmed technically by Differential scanning calorimetry (DSC), Scanning electron microscopy (SEM) and Atomic force microscope (AFM). Cationic dyeing showed brighter and more even dyeing properties of the collagen modified fabrics compared to the non-treated fabrics. From DSC results, it was found that the thermo-stability of the non-treated and collagen modified fabrics changed a lot. The morphology of different samples from SEM and AFM also approved the immobilization of collagen. The moisture absorption and hydrophilicity of the fabrics after collagen immobilization improved compared to the non-treated fabrics.

Introduction

Polyamide fiber is a widely used synthetic polymer because it has a combination of strength, flexibility, toughness, and abrasion resistance, however, shortcomings including the low light resistance and heat resistance, the moisture regain is lower than natural fibers and viscose rayon fibers cannot be ignored [1]. Polyamide fiber is an aliphatic polyamide characterized by recurring amide groups (–CONH–) in the polymeric chain and amino and carboxylic end groups. The amount of hydrophilic groups is relatively low, so the moisture absorption and vapor permeability are relatively poor, and lead to poor sanitary property. Therefore, increasing the amount of hydrophilic groups of polyamide fiber is a significant way to improve its sanitary property. Modification methods of polyamide fiber refer to blend spinning, surface grafting under the radiation with electron-beam and surface modification using plasmas, enzyme and supercritical CO_2 fluid are developed to improve those properties [2-6].

Collagen is a typical gender polyelectrolyte with amino-terminal, carboxyl-terminal and side-chain acidic groups and basic groups, generating peptides and amino acids after hydrolysis, producing a large number of hydrophilic groups (carboxyl, amino, hydroxyl, etc.). There are researches about surface modification of cotton with collagen and collagen blend with synthetic fiber [7-9]. The collagen used in this study was derived from the waste shavings of leather industry, so the utilization of collagen, not only because of its available properties and reactivity, but also because of the benefits of using leather wastes from leather industry. The aim of this study was to improve the moisture absorption and hydrophilicity of polyamide fibers by immobilizing collagen onto the moderate acid activated fabrics.

Materials and methods

Main Materials. Standard plain weave nylon 6 fabrics from Wu Jiang Jinrun Textile Co., Ltd. was used, Nonionic detergent was used for scouring the nylon 6 fabric. The acid used was sulfuric acid from Beijing Chemical Plant. The collagen used is derived from leather wastes in our laboratory. The glutaraldehyde solution (50%) is from Tianjin Kermel Chemical Reagent Co., Ltd. The Cationic Brilliant Red 5GN is provided by DyStar Company