

CREATING HIGH DENSITY COLORS ON BROWN WOOL FIBER

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Abstract: *Dichlorotriazine dye was selected for dyeing wool fiber in the research work. This class of active dye has high reactivity and covalently binds to fiber at low temperature and weak alkaline environment. The results of the experiment showed that in order to preserve the valuable properties of wool fiber, it is possible to reduce the duration of the dyeing process and create colors with high color intensity without using organic compounds.*

Keywords: *low temperature, finishing, coloring agent, alkaline agent, cationic surfactant, dyeing process, reactivity.*

INTRODUCTION

Currently, protein fibers are widely used in textile industry branch enterprises, especially for the processing of pure wool fiber or its mixture of other fibers, yarns with high color intensity of different linear densities, wool yarns, all kinds of technical and special yarns, carpets and carpet products and other materials are being produced [1, 2]. Wool fiber has been the main means of clothing for people since ancient times, and until now it is used in the textile industry as a wide consumer product due to its unique properties. Wool fibers with vapor and air permeable, water absorbing and insulating properties are an unparalleled fiber raw material for expanding the range of household and technical textile materials. By treating protein fiber fabrics with various nanocomposite materials, it is possible to control their changes under the influence of temperature and environment, their properties such as sorption and vapor transmission, electrification.

In accordance with the field of application of textile products made on the basis of wool, there are chemical finishing processes that ensure its morphological characteristics, supramolecular structure, physico-mechanical and hygienic properties. It is innovative to create high-intensity, durable colors on woolen fiber fabrics through digital dyeing technologies.

MATERIAL AND METHODS

The wool fiber of the local "Hisori" breed with a diameter of 55.35 μm and a length of 12-14 mm was taken as the research object. The amount of fat in the fiber is 11.2%, the amount of waste is 2.4%, and the moisture is 5.3%. Before dyeing, coarse wool fibers are treated in a solution containing SAM (1 g/l), sodium carbonate (up to pH =9) and soap (1.5 g/l) at a temperature of 45-50°C for 50-60 minutes. washed, then the second stage of the process is carried out in a solution containing 12 g/l hydrogen peroxide and 2 g/l ammonium hydroxide at a temperature of 60°C for 45-60 minutes is increased. Although the washed wool fiber has wettability, its brown color does not allow to obtain the required color and shades. In the next stage of the experiments, washed brown wool fibers were heated for 45-60 minutes at 60°C (melting modulus 50) containing 30% hydrogen peroxide (12-20 g/l), surfactant (2-4 g/l) and It is decolorized in a solution containing 25% ammonium hydroxide (up to pH =9). Dichlorotriazine dye was selected for redyeing washed and bleached wool fibers. Sample Staining Procedures DL-2003; Made in Water Bath Shaker (South Korea) unit. The pH environment of the painting surface was determined by the pH-meter "HANNA" instrument HI2210-02 (Germany), the color characteristics were determined by the X-ride Ci780 laboratory spectrophotometer at D65 standard radiation (Korea) [3].

RESULTS

This class of reactive dyes is characterized by high reactivity, forming covalent bonds with the fiber at low temperatures and in a mildly alkaline medium [4]. In terms of resource efficiency, dyeing wool and applying final finishing processes at low temperatures can also be carried out using acrylamide and silver citrate under similar conditions. To increase the amount of dye covalently bonded to the fiber, the pH of the medium was adjusted to 8–9 for wool prior to washing, following the dyeing of the protein fiber under acidic or neutral conditions. In this process, the disruption of ionic bonds takes place, and if the dye is in its active state, covalent bonds may form under mildly alkaline conditions. Hydrolyzed dyes, in contrast, are more easily detached from the fiber during washing [5–9].

DISCUSSION

The continuous dyeing process of wool fibers was carried out according to the following technology: The dyeing process is conducted in a solution containing the dye (4% by weight) and acetic acid (until pH=5-6) at a temperature of 35-40°C for 30 minutes. After the appropriate time has passed, the dyeing solution is cooled to 20°C, and ammonia (2-4%) is added until the solution reaches a pH of 8-8.5. The dyeing process is then continued for an additional 60 minutes. The dyed samples are then washed first in warm water, followed by cold water, then washed in a 2 g/l surfactant solution at 40°C for 10 minutes, and finally dried. The experimental results are presented in the following figure.

The data presented in the figure regarding the washfastness of the color indicate that ionic bonding between the dye and wool keratin occurs under mildly acidic conditions,

while covalent bonding forms under mildly alkaline conditions. When the color intensity is added to the dyeing solution with an alkaline agent, we can see that the color intensity of the wool fiber increases by 40-44% when pH=8-9 compared to that in a weak acid environment, due to the covalent binding of the dye desorbed from the fiber substrate to the active centers of the fiber.

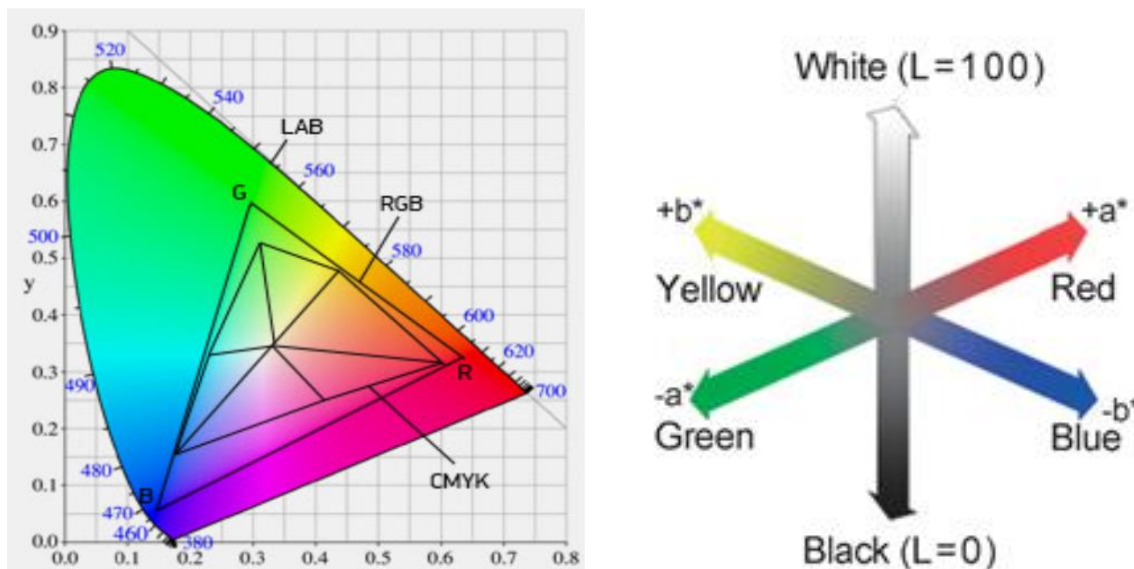
Table. Quality indicators of wool fiber dyed with lanazol red

Solution pH medium	Color intensity, K/S	Color smoothness, %	To wash the color durability, score
4	14,8	15,2	5/4/5
5	15,4	18,9	5/4,5/5
6	16,2	22,1	5/4,5/5
7	17,4	18,9	5/4,5/5
8	21,8	17,4	5/4/5
9	23,9	14,8	5/4/5

But due to the high availability of active dye nutrition, especially highly reactive dyes to the wool fiber, color smoothness in all conditions indicates a disease state. Color intensity $B = 683$. Color clarity (V , kd/m^2) using Y , (kd/m^2) as well as refractive index coefficient (R , %) by Gurevich–Kubelki–Munk (K/S) function (1) the color intensity of the samples was calculated. White color coordinate in Y_0 -XYZ system. D_{65} is equal to $Y_0=100$ in standard lighting.

$$\frac{K}{S} = \frac{[1 - 0.01 R]^2}{2[0.01 R]} \quad (1)$$

Here: R -ray reflection coefficient; K/S -color intensity; Complete absorption of K -rays; S -ray scattering. There are many pairs of identical radiations. A graph is used to determine them (picture). As can be seen from the graph, there are no complementary colors in the spectrum for radiations with a wavelength between 494÷570 nm.



Picture. CiE Lab color space model [10]

However, due to the high affinity of active dyes, especially those with high reactive capacity, for wool fibers, color uniformity showed negative results under all conditions. This issue was resolved by adding a cationic surfactant (1 g/l) to the dyeing solution. The color uniformity of the samples ranged from 0.8% to 0.9%, depending on the pH of the environment. The formation of a weak complex between the cationic surfactant and the dye slowed down the reaction, resulting in improved color uniformity.

Conclusion. The experimental results indicated that it is possible to achieve high color intensity while preserving the valuable properties of wool fibers by shortening the dyeing process duration, without using organic compounds. The longest stage in the dyeing wound is the penetration of dyes into the fiber device. The dye molecule overcomes the fiber walls and walls. Accelerating the dyeing process can also be achieved by breaking down the wool fiber cuticle to a certain extent. Through the proposed dyeing technology, in order to preserve the valuable properties of the wool fiber, the possibilities of reducing the duration of the dyeing process and creating colors with high color intensity without using organic compounds were studied.

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