International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-11 Issue-3, February 2022

The Effect of Bleach on The Linen Fabrics

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Abstract*: *Some contaminants of textile materials and products can only be removed with bleaches. It is believed that bleach gives the products sterility, whiteness and a beautiful appearance. Bleaches can be part of synthetic detergents, and are also used independently. Often, manufacturers of bleach claim that they contribute to improving the properties of textile materials. The task of the study is to establish the effect of bleaches on the structure and properties of tissues.

Keywords: Bleach, Fabric, Materials, Linen, Textile

I. INTRODUCTION

Household bleaches on the market have a fairly wide spectrum of action, they are used for washing materials and products of different fibrous composition, have an unequal nature of exposure. Depending on the nature of the effect, bleaches are divided into chemical and optical. The composition of chemical bleaches includes oxygen-containing, chlorine-containing and sulfur-containing bleaching substances. Thus, the relevance of the study is explained by the need to study the effect of household bleaches sold through a retail chain on the properties of linen fabrics. During washing, fabrics are exposed not only to chemicals (deter-gents, bleaches), but also to the mechanical effect that washing machines have on these materials. When planning the experiment to eliminate mechanical influences, washing in the washing machine was excluded. The pure effect of bleaches on linen and cotton fabrics was studied

II. LITERATURE REVIEW

Research on the bleach market has shown that oxygen-containing bleaches are the most common. In addition to cleaning abilities, they have additional disinfectant properties. The composition of such bleaches includes hydrogen peroxide, sodium perborate, sodium percarbonate, urea perhydrate and potassium monopersulfate. These bleaches release oxygen. Oxygen oxidizes unstable organic contaminants, and they either pass into the solution or form new compounds that are easily removed from the fibers of the material by the detergents used. These bleaches are not used to clean wool, silk and synthetic fabrics due to the recommended high temperatures of the washing process (about 80-90 ^{0}C). Chlorine-containing bleaches are the most effective, they act at any temperature. However, it is now known that they cause significant harm to the environment, which reduces their prevalence. Chlorine-containing bleaches include sodium hypochlorite, potassium and sodium dichlorisoceanurates. For the bleaching of woolen and silk fabrics, chlorine-containing bleaches cannot be used, as they destroy these materials. Chlorine-containing bleaches are used for washing cotton, linen and polyamide fabrics. Chemical com-pounds that make up bleaches emit chlorine, which has a pungent odor, and in high concentrations is poisonous. The group of sulfur-containing bleaching substances includes sodium hydrosulfate, ronhalite and thiourea. Sulfur-containing bleaches by the nature of their impact are universal, they can whiten fabrics of any fibrous composition at any temperature. However, they emit sulfur dioxide, which also has a pungent odor and is poisonous in high concentrations. It is also possible to give the tissues increased whiteness with the help of optical brighteners. As such, colorless substances are used that fluoresce in the blue or purple part of the spectrum. The additive synthesis of blue and yellow rays reflected by the bleached material causes a bright white color sensation. The effect of fluorescence is reduced to a decrease in yellowness and an increase in lightness. The disadvantage of optical whitening is that the fluorescent effect is greatly reduced under the influence of external factors. They have low strength to the action of water, alkalis, chlorine, hydrogen peroxide solution. In addition, they have low translucency. Excess optical bleach, which has its own color, worsens the whiteness of the fabric and leads to its graying and yellowing. [1]

Manuscript received on December 22, 2021.
Revised Manuscript received on December 29, 2021.
Manuscript published on February 28, 2022.
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III. RESEARCH METHODS

The effect of bleach on cellulose materials is the object of research. To conduct the study, four bleaches were purchased in the retail trade network, two of which were chlorine-containing, one - oxygen and another - optical. Cotton and linen fabrics for linen purposes were chosen as objects of research. The materials are new and purchased in the trading network. Cotton fabrics (coarse calico and madapollam) and linen fabrics are applied starch apprete, and linen fabric is also applied to a shrink finish. Fabrics produced by plain weave. It is known that the plain weave has the greatest strength and equilibrium structure, it provides sufficient strength of fabrics, low extensibility and resistance to relative shear of both the main and weft threads. Linen fabric has colored stripes, calico is painted blue, and madapollam is white. Thus, it is possible to evaluate not only the washability with bleach, but also the color resistance of materials to their effects. When planning the experiment to exclude mechanical influences, washing in the washing machine was excluded.

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The net effect of bleach on linen and cotton fabrics was studied. The effect of household bleach on such properties of fabrics as: density, shrinkage, color resistance to physical and chemical influences, tear and tear strength, whiteness and different shade was determined. The change in the density of the location of threads in fabrics, the thickness of materials, tensile strength and elongation, shrinkage were determined by standard methods. The number of bleach exposure cycles was as follows: 1, 5, 7, 10, 15, 30, 40. [2-10] The determination of whiteness and different shades was carried out on the instrument spectrocolorimeter "Pulsar", which is designed to measure the color characteristics of luminescent and non-luminescent materials. The principle of operation of the device is based on simultaneous measurement of reflection or transmission coefficients at 24 fixed wavelengths in the visible part of the spectrum between 380-720 nanometers in one flash of a pulse lampюThe device is equipped with a microcomputer that mathematically processed the test results of samples. In the sensor of the device, radiation from a pulse lamp placed in a photometric ball creates diffuse illumination of the sample through a measuring hole in the ball. Samples of the tested material with a size of 70-100 mm are placed on this hole, and they must be stacked in several layers. The number of layers is chosen so that the addition of another layer does not affect the value of the reflection coefficient. The design of the photometric ball provides the measuring geometry of diff/8 and allows you to exclude or take into account the mirror component of the image using a shutter. The radiation transmitted through the sample or reflected from its sur-face is directed through the lens to the end surface of the light-water bundle. The diaphragm emits radiation from the surface of the sample, the radiation is transmitted to the measuring unit via a light harness. The light guide harness is fixed at one end on the surface of the photometric ball and is illuminated by diffuse light through a hole in it, the other end is connected to the light filter unit of the measuring unit through a connector. Initially, in the measuring unit, in order to exclude measurement errors, the dark values of the channel signals are measured, which are entered into the computer and stored in memory. Then the computer gives a command to the sensor to ignite the lamp. The light streams reflected from the surface of the measured sample are converted into electrical signals proportional to the transmittance or reflection coefficients of the measured sample in 24 fixed sections of the spectrum, which are amplified and integrated by photodetector integrators during the flash of the pulse lamp and, using a switch, are alternately fed to the input of an analog-to-digital converter. Electrical signals converted into a digital code are entered into a control converting device in which information is processed according to a specific program and the results of calculations are displayed on the display of the device. Depending on which mode of operation will be set for the computer, it is possible to obtain various measurements of samples. So, in this paper we used three modes:

1 – to determine the values of the color coordinate X, Y and Z;

4 – to determine L for lightness, saturation, S, color tone T;

6 – to identify white W (%) and yellowness G (%).

The number of layers adding samples to measure white – 3. Appendix 4-layer did not affect the change of the reflection coefficient.

The spectrocolorimeter was also used to determine the different shades in operating modes 1 and 4 of the computer. The number of layers in deter-mining the heterogeneity of tissues with a surface density of less than 250 g/m^2 is four.

IV. RESULT AND DISCUSSION

It was found the increasing of the actual fabric density after 20 cycles of exposure to bleach, and then decrease it. Chlorine-containing bleaches cause a sharp increase in density up to 30 washes, and then a sharp decrease in it. The greatest increase in density is caused by chlorine-containing bleaches in linen fabric and madapollam. The increase in density may be due either to the shrinkage of tissues after wet-heat treatment, as a result of which the removal of the appendages fixing the stability of the fabric structure occurs. Another reason for the increase in density may be a change in the phase of the fabric structure (bending of the warp and weft threads). In addition, it should be noted that the working solutions of bleach formed a slight foam during the testing process. Saponification was also observed in the samples, on the basis of which it can be assumed that surfactants were introduced into their composition, although this is not reported in the information on the package. Surfactants can be of cationic and anionactive origin, but cationic surfactants are too expensive, therefore, anionactive surfactants that have a high resistance to fibers were probably used. The accumulation of these surfactants on the fibers can lead to compaction and gluing of the fibers. As a result, a denser structure is formed. After 30 and 40 washes, there is a decrease in the actual fabric density. This is caused by the chemical effect of bleach on the fibers of the fabric, as well as a change in the phase of the structure of the fabric, which depends on the bending of the warp and weft threads, and on their thickness. The relative density increased after 30 washings in samples of linen fabric and madapollam, and then decreased. In the samples of calico, it remained constant on the warp thread and increased on the weft spread. It was revealed that the greatest shrinkage is given to tissues under the influence of oxygen bleach, and the least – under the influence of chlorine-containing bleach. Depending on the amount of shrinkage, fabrics for various purposes are divided into three groups: non-shrinking - shrinkage along the warp and weft does not exceed 1.5%, low-shrinkage - up to 3.5% and up to 2%, respectively, shrinkage - up to 5% and up to 2%. The maximum shrinkage is observed in samples of linen fabric, both in the warp and in the weft. If the weft shrinkage under the influence of optical and oxygen brighteners is within the normal range, then on the basis it exceeds the permissible standards by 2-4 times. For coarse calico samples, there is also a change in linear dimensions, but only on the warp thread the shrinkage is positive, and on the weft thread - negative, that is, the samples are stretched.

Retrieval Number: 100.1/ijeat.C33330211322
DOI: 10.35940/ijeat.C3333.0211322
Journal Website: www.ijeat.org

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The stretching of coarse calico samples along the weft is due to the fact that there was a sharp shrinkage of the warp threads, which, bending, receive internal stress, while another sys-tem of threads presses on them, which straightened out as a result of wet-heat exposure. In other words, there was a change from one phase of the fabric structure to another, as a result of which the tissue became non-equilibrium.

All investigated tissues are composed of hydrophilic fibers, the main constituent of which is cellulose; therefore, a change in linear dimensions can also occur at the molecular level. The cellulose swells when exposed to the bleach solution, causing the fibers to grow in diameter. This leads to an in-crease in their ability to deform.

As the number of washings in the bleach solution increases, only the color tone and yellowness change sharply.

Moreover, in white samples of madapollam, first after 5 washings, the whiteness increases and then decreases. With a decrease in whiteness, the yellowness increases sharply. These changes after 5 washes are recorded only by the device, and with the naked eye, yellowing is observed only after 10 washes.

The same situation is observed when the samples are exposed to linen.

Samples of plain-dyed coarse calico under the influence of chlorine-containing bleaches changed color with each cycle of exposure and after 30 washings became white. Oxygen and optical brighteners slightly changed the color of the blue calico. The color tone of the coarse calico samples changed sharply.

Thus, chlorine-containing bleaches most actively affect the color characteristics of fabrics.

Long-term use of optical brighteners increases the yellowness in all fabrics, and in dyed coarse calico leads to a fading effect.

A change in the color characteristics of fabrics was found, starting from the 10th cycle of exposure to bleaches.

It was determined that the treatment of textile materials with chemical bleaching agents reduces their strength. There is a decrease in the breaking load and an increase in elongation up to 15 cycles of exposure to bleaches for chlorine-containing bleaches.

With a larger number of exposure cycles, there is a slight increase in the magnitude of the breaking load associated with a change in the structure of macromolecules. Ultimately, however, bleaches have a gradual destructive effect on the test materials.

Resistance to tearing load is steadily reduced under the influence of all bleaches in all fabrics.

V. CONCLUSIONS

Thus, it was found that all studied bleaches affect the structural and strength characteristics of fabrics, as well as reduce their aesthetic properties. In this case, the consumer should make a choice between the presence of a stain on the product or loss of appearance and strength after a number of exposure to bleach. In addition, one should remember about the impact of wastewater containing sulfur and chlorine-containing substances on the world around.

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Retrieval Number: 100.1/ijeat.C33330211322
DOI: 10.35940/ijeat.C3333.0211322
Journal Website: www.ijeat.org

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