DEVELOPMENT OF A METHOD FOR DETERMINING DURABILITY AND THE IMPACT OF THE AGGRESSIVE FACTOR ON MADE ASTRACT FILLED WITH MODIFIED UREA FORMALDEHYDE RESIN

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Abstract: This article discusses the results of research aimed at solving the problem of increasing the operational durability of dressed astrakhan fur in a fur coat. To solve it, an approach was chosen based on an understanding of the physicochemical processes occurring in the material under the influence of operational factors. The use of the developed method, which gives an unambiguous assessment of the material, made it possible to investigate the dependence of the durability of the material on the parameters of the technological process of its manufacture.

Key words: astrakhan skins, urea-formaldehyde resin, retanning, dermis, hairline, fur production, astrakhan collagen, bakhtarma sides, aggressive environment, skin.

РАЗРАБОТКА МЕТОДА ОПРЕДЕЛЕНИЯ ДОЛГОВЕЧНОСТИ И ВОЗДЕЙСТВИЕ АГРЕССИВНОГО ФАКТОРА НА ВЫДЕЛАННОГО КАРАКУЛЯ НАПОЛНЕННОЙ МОДИФИЦИРОВАННЫЙ КАРБАМИДОФОРМАЛЬДЕГИДНОЙ СМОЛОЙ

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Аннотация: В данной статье рассматриваются результаты исследований, направленных на решение проблемы повышения эксплуатационной долговечности выделанного каракуля в шубе. Для ее решения был выбран подход, основанный на понимании физико-химических процессов,

протекающих в материале под воздействием эксплуатационных факторов. Использование разработанного метода, дающего однозначную оценку материалу, позволило исследовать зависимость долговечности материала от параметров технологического процесса его изготовления.

Ключевые слова: каракулевые шкуры, карбамидоформальдегидная смола, додубливание, дерма, волосянный покров, мехового производства, коллаген каракуля, стороны бахтармы, агрессивная среда, шкура.

At present, the combination of technological processes that contribute to the saving of water and materials, the intensification of production, is very relevant at the present stage of development of leather production. Of great importance is the synthesis of new chemical compounds for retanning and filling leathers. To combine processes, it is necessary that materials with tanning properties have certain dimensions for cross-linking collagen chains and filling the structure of the dermis [1]..

As a result of finishing processes, the dermis is filled with dyes, fats and fillers. The specific surface area decreases, the total pore volume increases. The reason for this is the filling of pore volumes, mainly of medium diameter: their number is reduced to 25% of the total volume when using FSC and to 32% with MCFS. Therefore, the use of MCFS with a higher molecular weight leads to the filling of pores mainly with a diameter of 0.003-0.020 nm. At the same time, MKFS gives the dermis greater porosity compared to KFS, potassium alum, etc., Karakul is characterized by better ergonometric properties. According to organoleptic evaluation, the increase in hydrothermal stability and thickness turned out to be preferable.

Thus, MCFS has the necessary filling capacity, so its use excludes retanning and filling with other organic materials while maintaining the high quality of leather and fur.

It is known that water has a plasticizing effect on hair keratin, while changes in its structure and some of its properties occur [2,3]. The ability of keratin to absorb water is determined by the content of hydrophilic groups in its molecules. It should be expected that as hydrophilic elements in keratin decrease by modification (chemical, thermal, etc.), its ability to absorb water will also decrease.

In this regard, in this work, the chemical effects of the modified urea-formaldehyde resin of the karakul keratin protein, and their effect on the sorption properties of the hair of karakul skins, were studied. Comparable groups of hair keratin samples were prepared for the study, of which four samples and one as a control without treatment for comparison. Four samples were modified with various

functionally active substances with tanning and filling substances and, accordingly, with MCFS [4].

Given that the products of the fur industry are in constant ever-increasing demand, it is necessary to update and expand the range of high quality fur products, reduce costs and increase the volume of products. This problem can be solved through the use of new highly effective chemical materials in fur production, which have pronounced technological properties, thanks to which it is possible to activate the processing of fur raw materials [5,6].

Traditional dressing methods today do not allow obtaining leather materials with the required physical and mechanical, including hygienic, properties at the same time. Since the main disadvantage is that a change in the specified direction of physical and mechanical properties, as a rule, is accompanied by a deterioration in hygienic characteristics. To reduce these problems allows the use of new modified compounds of leather and fur semi-finished product. Treatment of astrakhan skins with modified aminoaldehyde oligomers after tanning processes is an environmentally safe and low energy-consuming technology compared to traditional processing methods [7].

To maintain competitiveness in the world market, local producers of astrakhan fur need to improve the quality of their products. The quality of raw materials has a significant impact on the commodity properties of products of the fur industry. Very often, the raw material supplied to the production of astrakhan has a different grade, as a result of improper skinning, increased bacterial contamination of the raw material, as well as a tendency to exfoliate the leather tissue. Therefore, some of the raw materials are low-grade. However, when worn, these leathers quickly get wet, dirty and lose their shape, which in turn leads to a deterioration in the hygienic properties of the natural material. To maintain the competitiveness of local astrakhan producers, it is necessary to improve the quality of their products. The quality of raw materials has a significant impact on the commodity properties of fur products [8,9].

In recent years, researchers have increasingly paid attention to chemical additives of an organic nature in the fur industry. The addition of small amounts of polymeric substances to the technological process allows, along with the intensification of processes, to increase the chemical and physical-mechanical properties of fur skins.

In the process of fur production, various chemical compounds are used, some of which are unsafe from an environmental point of view. The existing technologies for the synthesis of urea-formaldehyde resins are mostly outdated and for the most part do not meet international requirements and standards. In this regard, the search for modifiers for the production of resins in order to produce low-toxic materials and the introduction of a new filling technology for astrakhan skins is a very urgent task [10].

The creation of a new resin synthesis technology using an acrylic acid modifier and its application for the production of astrakhan fur will allow this industry to reach a qualitatively new level, ensuring that finished products that meet European standards are obtained, while the resulting products will belong to a higher price category [11,12].

One of the popular ways to improve the performance properties of products based on urea-formaldehyde resins is the modification of resins. Modification of urea resin and its use for filling fur can improve the environmental friendliness of finished products. The use of modifying additives to improve the environmental friendliness of fillers requires changes in the technological process at the level of technical solutions in obtaining resins and filling modes.

The method of modifying oligomers is the main and most effective way to impart the required properties. In most cases, low molecular weight compounds are used as modifiers, which have certain reactive functional groups, either change their physical nature, or act in a complex way. Since urea-formaldehyde oligomers, which have a significant amount of reactive methylol groups capable of interacting with hydroxyls, amino groups of the skin, are oligomeric compounds at the first stage, and the collagen matrix consists of high molecular weight chains, then in combination, due to cross-linking, they can give sufficiently elastic products . Thus, this problem predetermines the relevance of this direction [13].

Technological processes are never considered final; at certain stages, established processes are replaced by new, more progressive ones. This fully applies to the technology of fur production. First of all, it is necessary to improve the preparatory processes for processing fur, since it is here that the prerequisites are laid for the formation of the volume of the dermis, which ultimately determines the elastic-plastic and strength properties of the skins.

The operational durability of natural fur for clothing is not always satisfactory. There are cases of loss of strength with subsequent destruction of the fur.

An analysis of data on the operational properties of fur and a study of the nature of the destruction of the material in the product showed that the most characteristic type of destruction is cracking, which subsequently turns into peeling of the dermis from the hairline [14,15]. Most often, cracking begins in places of greatest potto exposure and contact with the human body, lining, both in stressed and non-stressed areas. This can be explained by the effect of an aqueous acidic environment on the fur material (acids are part of sweat and tannins, salts, and fattening substances can migrate during operation). Water for the skin tissue of dressed astrakhan fur is a chemically active agent that causes hydrolysis of dermal collagen, acidic and alkaline environment enhances hydrolytic aging. Warping and loss of shape of a fur coat made of astrakhan fur, due to a change in the linear dimensions of the material,

indicate the incompleteness of relaxation processes, the presence of internal stresses in the material, which is also the cause of its destruction [16].

This study discusses the results of studies aimed at solving the problem of increasing the operational durability of dressed astrakhan in a fur coat. To solve it, an approach was chosen based on an understanding of the physicochemical processes occurring in the material under the influence of operational factors. The methodology for solving this problem required the implementation of the following stages of research: the study of the destruction process of dressed astrakhan furs filled with modified urea-formaldehyde resin and without it, as well as the nature of the destruction of these furs under the influence of operational factors; development of a test method for an accelerated assessment of the durability of the SC; establishment of correlation coefficients between laboratory and operational tests; determination of the dependence of the durability of the dressed astrakhan fur filled with modified urea-formaldehyde resin on the technological parameters of the material manufacturing; development of ways to increase the durability of dressed astrakhan fur filled with modified urea-formaldehyde resin and their production testing [17].

When studying the processes of destruction of dressed karakul under the influence of operational factors, it was assumed that the aging of the polymer is accelerated in the presence of certain waste products of the human body (water, organic acids, urea, ammonia), metal ions, etc.

In the study of the nature of the destruction of astrakhan fur under the influence of technological and operational factors, samples of dressed astrakhan fur, heat treatment, exposure to water and aqueous solutions of hydrochloric acid. The concentration of the solutions was varied from 1 to 10%, the treatment temperature was from 50 to 100°C, and the deformation was from 0 to 30%. The contact of samples with an aggressive environment was carried out both from the side of the bakhtarma and from the side of the hairline. When tested in a stressed (deformed) state, the samples fixed in an annular frame were subjected to biaxial tension by pulling on a rigid hemisphere.

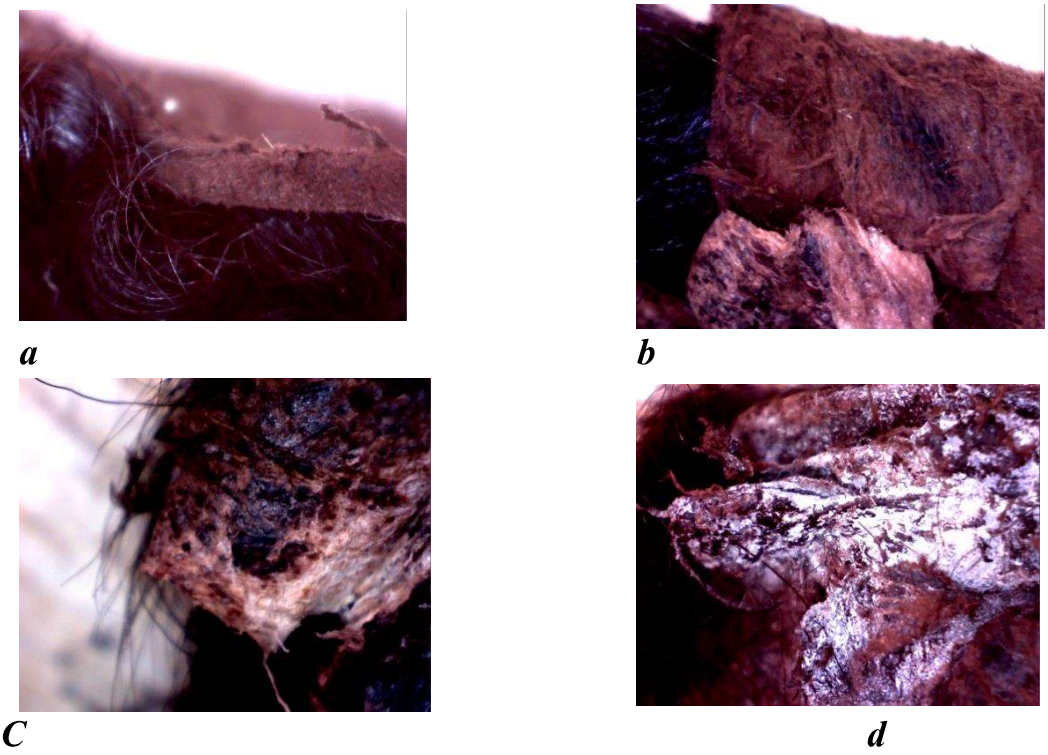
When testing samples in an unstressed state, it turned out that exposure to water at a temperature of 50 ° C leads to their destruction only after 60-90 minutes, exposure to hydrochloric acid solutions leads to destruction after 15-45 minutes (depending on concentration). With increasing solution concentration and processing temperature, the time to failure is rapidly reduced. It was also found that when processing samples from the side of the hairline, the time to destruction is 5-10 times less than when processing them from the side of bakhtarma [18].

These differences are due to the presence of the front layer on the outer surface. When the sample is exposed to a liquid medium from the bakhtarma side, the active components easily diffuse into the facial layer, penetrate to a considerable depth and

cause destruction of the face in the entire volume of the layer. Under the influence of the same components from the face, this process goes on for a long time.

Under the action of water and hydrochloric acid solutions from the bakhtarma side, destruction begins with the formation of cracks growing from defects (large pores) located in the front layer of astrakhan fur (Fig. 1a). Their size is 40-50 times larger than the size of the bulk of the pores of the facial layer and reaches 180-210 microns, the total volume of these pores is 6-12% of the volume of the dermis. With an increase in the duration of exposure to an aggressive environment, cracks grow to the front surface. Upon contact of the sample with an aggressive medium from the side of the hairline, destruction begins with the formation of microcracks in the front surface, which later, after a much longer period of time, grow into the volume of the front layer and reach the base (Fig. 1, b).

The destruction of stressed (deformed) samples under the action of an aggressive medium occurs much faster than the destruction of samples in an unstressed state.



a ***b***

C ***d***

Fig. 1. Microphotographs (150) of the cross section of the astrakhan of the original untreated sample (a): after exposure to an aggressive environment on the sample in an unstressed state from the side of the bakhtarma (b) and from the side of the front surface (c); after exposure to an aggressive environment on a sample in a stressed state from the bakhtarma side (d).

This corresponds to the notion that stress usually accelerates chemical processes, in particular the hydrolysis of the skin tissue of astrakhan fur. Thus, under the influence of an aggressive environment on a deformed astrakhan sample from the side of the hairline, the time of its destruction increases by 3.5-5.0 times compared to

an unstressed sample. The applied stress leads both to the acceleration of the appearance of cracks in the front surface and to the acceleration of their growth into the volume of the front layer.

When a deformed sample is exposed to an aggressive medium from the bakhtarma side, the first stage of sample destruction—the appearance of cracks in the most stressed places (on large pores)—also accelerates. Moreover, the process of formation of cracks and their growth in the front layer occur so intensively and quickly that the cracks, connecting with each other, lead to delamination of the front layer (Fig. 1, c). The fracture boundary passes at a distance of 260–280 μm from the bakhtarma [19].

Thus, under the influence of an aggressive environment on astrakhan specimens from the bakhtarma side, both in a stressed and unstressed state, the first stage of destruction of the front surface is the appearance and growth of microcracks in the most weakened places - on the surface of large pores. This indicates a significant influence on the process of destruction of astrakhan of the structural features of the skin tissue.

The results of studies of chemical processes occurring in the leather tissue under the influence of the external environment, and the nature of the destruction of astrakhan fur made it possible to choose the conditions for testing astrakhan skins for durability. The complex of factors was determined not on the basis of direct modeling of existing operational factors, but from such a selection of exposure conditions in the experiment, under which the external changes in the outer clothing material and the nature of its destruction would be reproduced. A complex of factors includes contact with a 10% hydrochloric acid solution, thermal exposure and material deformation. During the test, the behavior of the astrakhan fur in the openings of the outer clothing is imitated, the time from the start of the test to the destruction of the facial layer of the astrakhan fur is determined. The moment of destruction is fixed by the change in the air permeability of the sample. When testing karakul according to the developed method, it is possible to largely reproduce the nature of destruction in outer clothing and the chemical process of destruction of the finished karakul. The results of the laboratory evaluation of durability are consistent with the performance test data, which allows you to determine the proportionality factor between the durability in laboratory tests and the service life of the material in the shoe.

The use of the developed method, which gives an unambiguous assessment of the material, made it possible to investigate the dependence of the durability of the material on the parameters of the technological process of its manufacture [20].

Conclusion: The influence of aggressive environments on astrakhan skins was studied, and when exposed to the wool part of the aggressive environment, it was observed that microcracks formed on the destruction surface, which eventually

reached the size of the surface part and then the base. When determining the sorption properties of samples treated with MCFS, a further decrease in sorption properties and chemical binding of many hydrophilic groups were found.

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