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A COMPREHENSIVE METHOD OF SOAKING SHEEPSKINS WITH SULFURIZATION

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Soaking is the first and one of the most important preparatory operations in fur dressing. Soaking determines the successful completion of subsequent technological processes. The purpose of soaking is to bring the skin into a state close to paired state in terms of the amount and uniformity of moisture distribution in the leather tissue and hair. This makes it important to find the optimal soaking recipe. The classic soaking method leads to damage to the structure of the dermis, due to which the structure of the soaked dermis differs from the structure of the dermis in the paired state. To solve this problem, it is necessary to find an innovative soaking method that both meets soaking standards and preserves the structure of the dermis close to the paired state. This article discusses a comprehensive method for soaking sheepskins with sulfurization. An experiment was conducted with 4 batches preserved using different preservation methods. These batches were soaked using our suggested recipe, using sodium sulfate and sulfuric acid. As a result of the interaction of sodium sulfate with sulfuric acid, sulfur is formed, which interacts with the functional groups of collagen. This interaction is one of the ways to sulfurize the semi-finished product. In addition, the resulting sulfur affects not only the soaking process, but also subsequent processes, causing synergy in the technological process chain. Analysis of the process results allows us to conclude that this soaking method complies with established standards. Since the watering of the raw material in each of the preservation methods is above 65%, as well as the indicators of the structure of the dermis, soaked with sulfur, are close to the indicators of the structure of the dermis in the paired state.

Keywords: soaking, sulfurization, preservation, sheepskin, watering, sulfuric acid, semi-finished product.

КОМПЛЕКСНЫЙ СПОСОБ ОТМОКИ ОВЧИН С СЕРНЕНИЕМ

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Отмока является первой и одной из самых важных подготовительных операций выделки меха. Отмока обуславливает успешное протекание последующих технологических процессов. Целью отмоки является приведение шкуры в состояние близкое к парному по величине и равномерности распределения влаги в кожевой ткани и волоса. Это делает важным поиск оптимального рецепта проведения отмоки. Классический способ отмоки приводит к повреждению структуры дермы, из-за которого структура отмоченной дермы отличается от структуры дермы в парном состоянии. Чтобы решить данную проблему, необходимо найти инновационный способ отмоки, который одновременно соответствует нормам отмоки и сохраняет структуру дермы близкой к парной. В данной статье рассматривается комплексный способ отмоки овчин с сернением. Был проведен эксперимент с 4 партиями, консервированными различными способами консервировки. Эти партии были отмочены предлагаемым нами рецептом, с использованием сульфата натрия и серной кислоты. В результате взаимодействия сульфата натрия с серной кислотой образуется сера, которая взаимодействует с функциональными группами коллагена. Это взаимодействие является одним из способов сернения полуфабриката. Помимо этого, образовавшаяся сера влияет не только на процесс отмоки, но и на последующие процессы, вызывая синергию в технологической цепочке процессов. Анализ результатов процессов позволяет сделать заключение, что данный способ отмоки соответствует установленным нормам. Так как обводнение сырья при каждом из способов консервировки выше 65%, а также показатели структуры дермы, отмоченные сернением, близки к показателям структуры дермы в парном состоянии.

Ключевые слова: отмока, сернение, консервирование, овчина, обводнение, серная кислота, полуфабрикат.

ҚОЙ ТЕРІСІН КҮКІРТТЕУМЕН КЕШЕНДЕЛГЕН ЖІБІТУ ӘДІСІ

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Үлбірлік теріні өңдеу технологиясында жібіту процесі алғашқы және маңызды дайындық операцияларының бірі. Жібіту кейінгі технологиялық процесстердің сәтті аяқталуын қамтамасыздандырады. Жібіту мақсаты тері шикізатын сулануы бойынша да, ылғалдын таралу мөлшерін біркелкіге келтіру жағынан да, мал терісін жаңа сыпырылған күйге жақындату болып табылады. Бұл оңтайлы жібіту тәсілін табуды маңызды етеді. Классикалық жібіту әдісі дерманың құрылымының бұзылуына әкеледі, соның арқасында сіңірілген дерманың құрылымы жұптық күйдегі дерма құрылымынан ерекшеленеді. Бұл мәселені шешу үшін жібіту стандарттарына сәйкес келетін және теріні жаңа сыпырылған күйін сақтайтын инновациялық жібіту әдісін табу қажет. Бұл мақалада қой терісін күкірттеу кешендей әдісі қарастырылынған. Әртүрлі консервілеу әдістерін қолданып консервіленген 4 партиямен тәжірибе жүргізілді. Бұл партиялар натрий сульфаты мен күкірт қышқылын пайдаланып, біз ұсынған тәсіл бойынша суланған. Натрий сульфатының күкірт қышқылымен әрекеттесуі нәтижесінде күкірт түзіліп, коллагеннің функционалдық топтарымен әрекеттеседі. Бұл әрекеттесу жартылай фабрикатты күкірттеу тәсілдерінің бірі болып табылады. Сонымен қатар, пайда болған күкірт тек сіңіру процесіне ғана емес, келесі процестерге де әсер етіп, технологиялық процестер тізбегінде синергияны тудырады. Процесс нәтижелерін талдау бұл жібіту әдісі белгіленген стандарттарға сәйкес келеді деген қорытынды жасауға мүмкіндік береді. Консервілеу әдістерінің әрқайсысы үшін шикізаттың су мөлшері 65% жоғары болғандықтан, сондай ақ күкіртпен суланған дерманың құрылымының көрсеткіштері жанадаң сыпырылған күйдегі дерманың құрылымының көрсеткіштеріне жақын.

Негізгі сөздер: жібіту, күкірттеу, консервілеу, қой терісі, ылғандыру, күкірт қышқылы, жарттылай фабрикат.

Introduction

Leather and fur formed one of the most important groups of material to serve different human needs [1]. Around 8 million tons of wet salted hides and skins are converted into leather annually [2]. The European Union is the main exporter of pelts worldwide accounting for the 64% of the total production with the States of Denmark, Netherlands, Finland and Greece being the main producers. Other significant fur producers are the United States of America and China, with China being the main exporter of fur-derived commodities and clothing [3]. Sheepskins make up 6% of the raw material used by the world leather industry [4].

As for Kazakhstan, despite the great potential of the leather and fur industry, provided by new equipment, a huge raw material base, as well as established markets, the industry has significant problems. The only way to solve existing problems in a highly competitive environment is through innovation in the industry.

One of the effective directions for obtaining materials in an innovative way with high demand is the production of semi-finished products with high value, and lower costs spent in the processing of auxiliary materials, which affect the formation of the desired qualities of the material.

This article presents the findings of a comprehensive study on the sheepskin fur manufacturing process technology. This technology should have a multi-faceted impact, complementing the main and subsequent processes of dressing. One of the ways to solve this problem is to expand the impact of each process. The technology being developed in this case offers a solution by enhancing the influence of the soaking process on the formation of the semi-finished product's structure.

Soaking is the first and one of the most important preparatory operations in fur dressing. Soaking determines the successful completion of subsequent technological processes. Therefore, the purpose of soaking to saturate the skins with moisture and render them pliable for subsequent processing steps. [5].

Evolution has made the natural structure of the dermis most adapted to external physical and mechanical influence. In other words, the structure of the dermis in a paired state is the standard for any semi-finished product. However, classical soaking methods often result in structural damage to the dermis, due to which the structure of the soaked dermis differs from the structure of the dermis in the paired state. To solve this problem, it is necessary to find an innovative soaking method that simultaneously complies with soaking standards and maintains the structure of the dermis close to the paired state. This method is a comprehensive method of soaking sheepskins with sulfurization (можно ли добавить ссылку на источник, если есть).

Materials and research methods

The scientific and practical direction of the soaking process was studied through an experiment during which semi-fine fleece sheepskin skins were prepared. Then they were assembled into different batches, consisting of 4 sheepskins, with different methods of preservation. Salt curing i.e., using different salts, mostly sodium chloride, is the most traditional acceptable method, which is regularly practiced in most of the tanneries for hides/skin preservation [6].

Various preservation methods were selected to empirically validate the efficacy of sulfur-soaking sheepskins, particularly in the case of hides treated with different preservation techniques.

To study our proposed method of soaking raw materials for various preservation methods, the data of each batch of raw materials was studied and their properties were established. Physico-mechanical and chemical properties of raw materials are given in Table 1.

Table 1. Physical-mechanical and chemical properties of raw materials

Indicators	Batch 1	Batch 2	Batch 3	Batch 4
Method of preservation	Dry-salted preservation	Fresh-dry preservation	Preservation with Diammonium Phosphate	Wet-salted preservation
Area, dm^2	167	165	168	170
Weight of skins, kg	9,51	7,65	9,24	13,38
Hair thickness, μm	27	26	28	30

One of the skins from each batch was cut using the asymmetrical fringe method. Using the results obtained from the experiment with asymmetrical fringe, the four prepared batches were soaked. After this, following the accepted methodology, the effect of various preservation methods was studied.

The parameters of the soaking process under semi-production conditions were adopted based on the results of laboratory studies. In many

cases soaking is divided in two stages which can be called the first and the second soaking [7].

The soaking was carried out according to the following procedure. After the batch is completed, the raw materials are sent to the soaking process 1, which is carried out under l.c. 12, temperature 35 °C, for 10-12 hours. Bath composition: Sodium silicofluoride 1 g/l, Novost powder (Kazan Chemical Plant, Russia) 0.5 g/l. Next, wash for 10 minutes in running water at a temperature of 25-27 ^{o}C. After washing there is a soak 2.

The transformations of raw skins into leather are performed in particular reactors termed drums [8]. Soaking 2 was carried out under semi-production conditions in a wooden drum with a capacity of 200 liters at l.c. 8, and temperature 32 ^{o}C, for 12 hours. Composition of working solutions, concentration of substances: sulfonol 0.6 g/l, sodium sulfate 6.5 g/l, sulfuric acid 4 g/l was added within 3 hours. Prior to submerging in sulfuric acid, the specimen weights and diameters were measured [9]. Sodium sulphate (Na_2SO_4) have the properties as melting point around 900 °C, boiling point 1400°C, density 2.7gm/ml and soluble in water, glycerol and hydrogen iodide and insoluble in ethanol [10].

As a result of the interaction of sodium sulfate with sulfuric acid, sulfur is formed and engages with the functional groups of collagen. This interaction constitutes one of the pathways for sulfurizing the semi-finished product. In addition, the resulting sulfur affects not only the soaking process but also subsequent processes, causing synergy in the technological chain of processes.

Subsequently, a series of procedures were conducted, including drainage, spinning on an MM2-47 fleshing machine equipped with dull knives, haircut, fleshing, and washing-degreasing. After these processes, soaking control was carried out. The semi-finished product was checked organoleptically and its water content was determined. Next, the structure of the dermis was studied and compared with the structure of the dermis of paired-state skins.

Literature review

Surfactants are extensively used in various fields, such as textile, food processing, and petroleum. The market primarily offers three main types of surfactants: cationic, anionic, and nonionic surfactants. [11]. Surfactants are substances that adjust the surface tension of the target solution and change the steric hindrance between abrasive particles. Their molecular structure has hydrophobic groups at one end and hydrophilic groups at the other end [12]. Surfactants have amphiphilic properties resulting in affinity for polar and non-polar media [13].

Currently, most of the surfactants are longchain fatty acid ester surfactants with low wettability [14]. Compared with enzymes and nanocomposites, surfactants, as the most common chemical raw materials, have attracted much attention because they are used in almost all leather-making processes. Unfortunately, conventional surfactants need to cooperate with other auxiliaries and only promote the penetration of the auxiliaries to the skin during the application. Particularly, bactericides and dyefixing agents must be used in soaking and dyeing processes, respectively, which brings the waste of resources [15].

In our case, Novost powder and sulfonol act as surfactants. Sulfonol ranks first among surfactants produced in Europe and the United States. This is explained by the availability of raw materials, simplicity of the technological process, high surface-active properties, and low cost of the product. The Novost powder is based on a resource unique in its properties – cachalot fat. The selection of this resource was also influenced by its ready availability within our country.

Results and discussion

Proper soaking should ensure watering of the raw material with minimal loss of raw material; the skins should contain at least 65% moisture.

Checking the water cut in the studied processes showed the following results:

1st batch – 67%

2nd batch – 69%

3rd batch – 67.5%

4th batch – 71%

These data indicate that with any preservation method, soaking with sulfurization complies with established standards, which confirms the suitability of this soaking method.

A comparison of the structure of the dermis showed its closeness to the indicators of the structure of the dermis in the paired state. In this experiment, we employed a method that not only prepared for subsequent processes but also contributed to the homogenization of the results of the tasks being solved. Analysis of the results of the processes allows us to conclude that a sharp change in the composition of the reagents of the second soaking allows to change the structure of the skin to some extent. Which is the main objective of this soaking process. The soaking solution we propose showed its effect on the formation of the structure of the semi-finished product under study.

Conclusion

The soaking method we proposed has proven its effectiveness and compliance with established standards. Analysis of the results of the processes allows us to conclude that this soaking method meets the requirements for soaking methods. Since the water content of raw materials for each of the preservation methods is above 65%. And also the indicators of the structure of the dermis soaked with sulfurization are close to the indicators of the structure of the dermis in the paired state.

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