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Mass Carry During Convective Drying Of Astrakhan Skins

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Abstract – The article describes the process of convective drying of astrakhan skins, increasing the evaporation surface using a sorbent-hygroscopic material, the theory of its achievement, analytical dependences characterizing the evaporation of moisture from the surface of astrakhan fur and the amount of moisture evaporating from it, the rate of mass transfer from the surface of astrakhan fur with taking into account the intensity of movement of moisture sorbent - hygroscopic material from astrakhan skins.

Keywords – drying; astrakhan; skin; dehydration; acceleration; convective drying; capillary-porous; intensity; gradient; temperature; mass carry; diffusion; moisture; sorbent; hygroscopic material; sorption; desorption.

I. Introduction

Karakul sheep breeding is one of the main treasures of Uzbekistan. Karakul sheep - allows you to get products such as astrakhan skins, wool and meat. Karakul skins are distinguished by the sheen of wool, grace, lightness, subtlety, beauty of various flower forms [9]. The quality of the obtained karakul skins depends on its timely processing, that is, timely cleaning of the skins from fatty meat layers, salting, drying, cleaning from salt and mechanical impurities. If the initial treatment of the skin is prolonged or incorrect (one part of the skin is dry, the other is not dry), then irreversible biochemical processes occur, as a result of which the quality of the skin deteriorates. Its price drops to 11 ... 34% [5,6,7,8,9].

Therefore, it is recommended to carry out drying (one of the ancient methods of canning), which is part of the primary processing of the skins, using advanced intensive technology. At present, karakul is dried naturally, mainly in the open air, in the sun, although various dryers have been developed [14].

This drying method has the following disadvantages, depending on weather conditions, the inability to provide the required technological regime (temperature, humidity and air speed), pollution by external pollution, large labor resources and sites, and artificial drying requires a large amount of energy, and so on. In addition, when prolonging the drying process of the skins (using the traditional method), the penetration (shrinkage) of the skin surface is 15 ... 18%, and the drying time is 48 hours.

The analysis of theoretical studies shows that in many works carried out to date to explain the mechanism of mass carry during the heat drying of astrakhan skins, the mechanism of moisture movement with a uniform moisture content of the material is considered. In this case, at the beginning of the drying process, when the surface layers of astrakhan skins warm up, the moisture content of the latter becomes higher than equilibrium. Therefore, moisture from the surface of the material to be dried begins to evaporate in the form of steam. As a result of moisture evaporation, a moisture content difference is created on the surface of the material between the subsequent layers and the surface layer, and a moisture concentration gradient appears in the astrakhan skins. Under its action, moisture in liquid form moves to the surface of astrakhan skins. The moisture inside the material is mixed not only by the moisture gradient, but also by the temperature gradient. However, the presence of a temperature gradient within the material complicates the mass carry mechanism.

II. Materials and methods

During convective drying of astrakhan skins, the temperature gradient causes a flow of moisture from the inside of the leather tissue to its surface, that is, the opposite flow of moisture caused by the moisture content gradient.

Mass carry in colloidal capillary-porous bodies, which, according to A.B. Lykov's classification, are astrakhan skins, is described by the formula [1,2,6,7].

$$J = -a_m \rho_0 (\Delta U + \delta \Delta Q), \qquad (1)$$

where, J - intensity of the transfer mass, kg/m^2 s;

a_m - moisture diffusion coefficient, kg/m^2;

ρ_0 - mass of absolute dry matter per unit volume of wet material;

ΔU - moisture content gradient, kg/kg m;

ΔQ - temperature gradient, ^{0}C/^{0}C m;

δ - coefficient of thermo-moisture conductivity of the material.

Analysis of expression (1) shows that the intensity of the process of mass carry depends on the coefficient of diffusion of moisture in the material, the gradient of moisture content and temperature. It should be borne in mind that the direction of the gradients of moisture content and temperature are opposite.

From the above, it can be seen that the use of a convective drying method is advisable for drying astrakhan skins with a uniform moisture content.

III. Results and their analysis

As you know, in astrakhan skins, moisture is mainly found in skin tissues (epidermis, dermis, subcutaneous cell) $W_{\hat{E}\grave{O}}$.

With the convection method of drying astrakhan skins, the moisture in the layers of the $W_{\hat{E}\grave{O}}$ leather fabric moves to the surface, the moisture content of which is $W_{\hat{I}\hat{E}}$, since $W_{\hat{E}\grave{O}} > W_{\hat{I}\hat{E}}$. The movement of moisture from the inside of astrakhan skins occurs due to the difference in the moisture content of the components (moisture moves from a place of higher humidity $W_{\hat{E}\grave{O}}$ (skin tissue) to a place of lower humidity $W_{\hat{I}\hat{E}}$ (astrakhan surface) and under the influence of a temperature gradient.

When using sorption-contact dehydration of astrakhan skins, the moisture on the surface is absorbed by the sorbent-hygroscopic material.

The sorption-contact method of dehydration of astrakhan skins is based on the principle of moisture redistribution between them and the sorbent in this case, hygroscopic material.

When materials come into contact with different moisture content, a natural process of moisture redistribution occurs between them. Basically, moisture is transferred by mutual sorption-desorption. These materials strive for hydrothermal equilibrium, which is determined by the potential difference of mass carry. In the state of hydrothermal equilibrium, the potentials of mass carry between bodies in contact are equal, and the specific moisture content is not the same, their ratio is proportional to the ratio of the moisture of the containers [1,2].

$$Q_1 = Q_2 ; \frac{U_1}{U_2} = \frac{C_{M1}}{C_{M2}} ; \qquad (2)$$

where, Q_1 - potential of mass carry of hygroscopic material;

Q_2 - potential for mass carry of astrakhan skins;

U_1 - moisture content of hygroscopic material, kg/kg;

U_2 - moisture content of astrakhan skins, kg/kg;

C_{M1} - moisture capacity of hygroscopic material;

C_{M2} - moisture capacity of astrakhan skins.

Let us consider how the process of sorption-contact dehydration of astrakhan skins takes place. Let the initial moisture content of the hygroscopic material, the sorbent, be zero, and the astrakhan skins have some moisture content $W_{ÊÒ}$. At the initial moment of time ($\tau = 0$),when the skins have not yet been glued to the hygroscopic material - the sorbent, the moisture concentration in the astrakhan skins $W_{ÊÒ} = C_{Ì\ 2}$, and in the sorbent - the hygroscopic material:

$$W_{ÃÌ} = C_{Ì\ 1} = 0, \qquad (3)$$

where, $W_{ÊÒ}$ - moisture content of astrakhan skins, %;

$W_{ÃÌ}$ - moisture content of hygroscopic material - sorbent, %.

In astrakhan skins, after the end of the process of gluing to the hygroscopic material-sorbent, in a time interval close to the initial one, contact interaction occurs. The moisture content of the sorbent-hygroscopic material, after contact (gluing) with the astrakhan skins, increases due to the absorption of moisture from the latter, the moisture content of the hygroscopic sorbent material and astrakhan skins is equalized, as a result of which the moisture content of the astrakhan skins decreases, that is, $W_{ÃÌ} = W_{ÊÒ} \neq 0$.

The rate of mass transfer from the surface of astrakhan skins, taking into account the intensity of mass carry to the sorbent - hygroscopic material, is described by the expression [1,2,3,4,5]:

$$\frac{dW}{d\tau} = k(W_{ÊÒ} - W_{Ð}), \qquad (4)$$

where, $\frac{dW}{d\tau}$ - mass transfer rate (mass carry);

k - coefficient taking into account the sorbent properties of astrakhan skins and sorbent - hygroscopic material under identical conditions;

$W_{\hat{E}\grave{O}}$ - moisture of astrakhan skins before sorption drying, %;

W_{D} - equilibrium moisture content of astrakhan fur, %.

Drying of skins using a fixative was carried out in 2 groups - 2 control and 8 variants in the sheep breeding farm of the LLO "Tim-Agron Chorva" in the farm "Agron" in the Nurabad district of the Samarkand region (Figure 1).

Figure 2 shows an experimental drying test using a skin fixation device.

Figure 3 shows the results of experimental drying of skins using a fixative.

According to the results of experiments, a hygroscopic material woven from yarn with a diameter of $d_н$ = 0,05… 0,07 mm allows moisture to evaporate from the surface of the skin, but you can use a hygroscopic material with a diameter of $d_н$ = 0,8… 1,2 mm due to the high cost canvas is this kind of material. This distance changes slightly (deforms) along the surface during the drying process of karakul, if the skins are attached to fixing devices, which allows the skin surface to remain in dimensions close to the original, pre-dried surface.

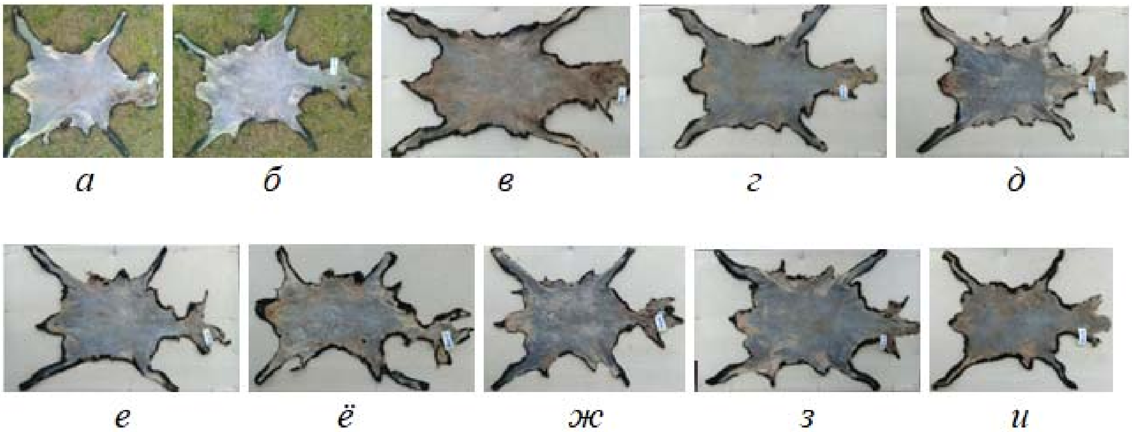

Figure 1. Initial conditions of the experimental test: а, б - skins of the control group; в, г, д, е, ё, ж, з, и - in the experimental group 1, 2, 3, 4, 5, 6, 7, 8 variants of skins.

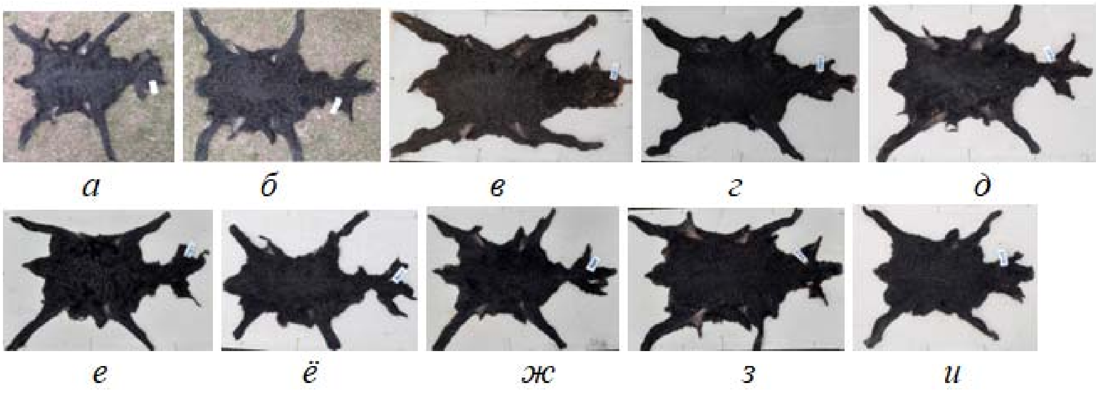

Figure 2. Experimental tests: а, б - skins of the control group; в, г, д, е, ё, ж, з, и - in the experimental group 1, 2, 3, 4, 5, 6, 7, 8 variants of skins.

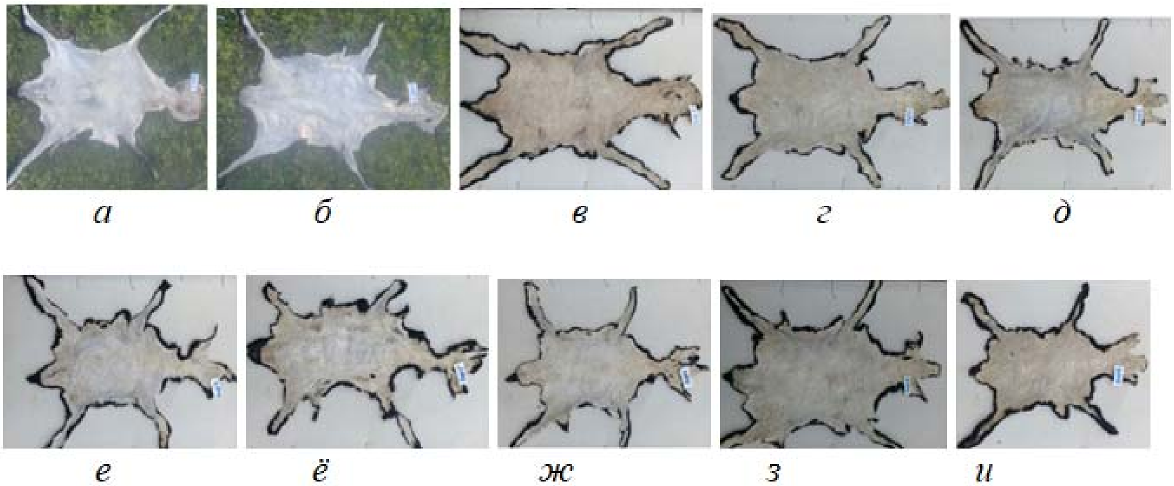

Figure 3. Results of experimental tests: а, б - skins of the control group; в, г, д, е, ё, ж, з, и - in the experimental group 1, 2, 3, 4, 5, 6, 7, 8 variants of skins.

In this case, the deformation is mainly formed by the thickness of the skin layer, which changes relatively significantly during the drying process [9]. It is also possible to continue the drying process in poor weather conditions by placing the cassettes of the fixing device in the rack dryer for blocks (Figure 4).

During the drying of astrakhan fur, the cassette of the fixing device adheres to the hygroscopic material, increasing the surface area of moisture evaporation from the skin surface, which accelerates the drying process of the astrakhan fur, which leads to a decrease in the shrinkage of the skin surface.

To accelerate the drying of astrakhan fur when drying astrakhan fur, it is advisable to use fixer cassettes made of hygroscopic material to ensure moisture evaporation from the skin surface.

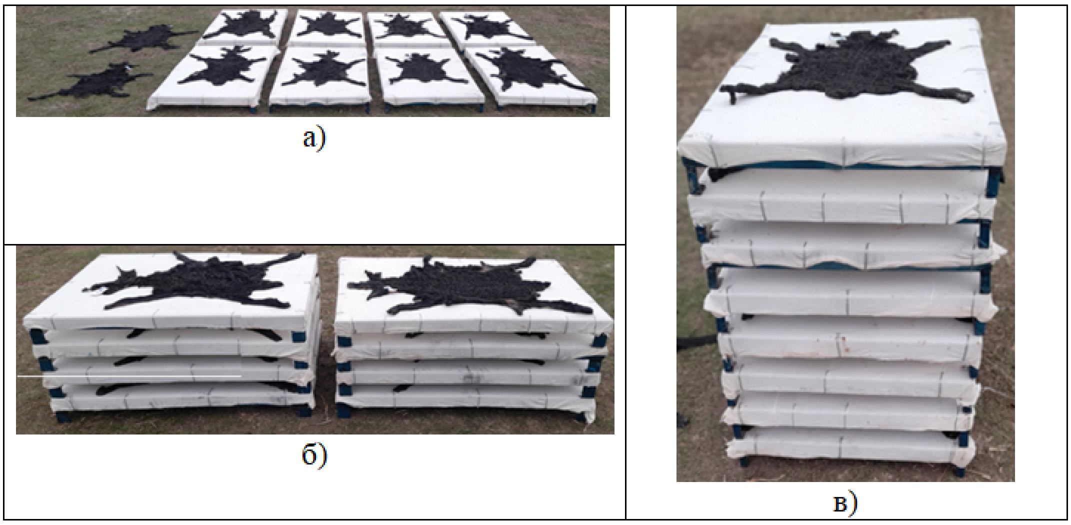

Figure 4. The process of drying karakul without fixing (sticking) to the hygroscopic material of the fixing device: а) the cassettes are laid out; б) cassettes in small groups; в) stack-type cassettes.

The use of fixing cassettes when drying karakul from expressions (1), (2) and (3), along with improving the surface and drying quality, ensures that the dried skins are stretched and stretched over the entire surface, resulting in less shrinkage of the skin surface during drying.

IV. CONCLUSION

Analysis of expression (4) shows that the intensity of mass transfer depends on the sorption properties of the hygroscopic material.

The result of the analysis of the second part of expression (4) shows that the dehydration of astrakhan skins depends on their initial moisture content $W_{\hat{E}\grave{O}}$ and sorbent - hygroscopic material $W_{\tilde{A}\grave{I}}$. The dehydration process occurs at $W_{\hat{E}\grave{O}} > W_{\tilde{A}\grave{I}}$, that is, the hygroscopic sorbent material absorbs moisture from the astrakhan skins, and at $W_{\hat{E}\grave{O}} = W_{Đ}$, an equilibrium state occurs, the drying process stops. Consequently, the greater the difference $W_{\hat{E}\grave{O}} - W_{\tilde{A}\grave{I}}$, the more intensive the process of sorption-contact dehydration of astrakhan skins proceeds.

REFERENCES

[1] Handbook of heat exchangers. Volume 1. Translation from English, edited by B.S. Petrukhov, V.K. Shikov. - M .: Energo-Atomic Publishing House, 1987. - 560 p.

[2] Spalding.D.B., Numerical Computation of Multi-phase Fluid Flov and Head Transfer, in Recent Advances in Numerical Mechanics, ed C.Taylor Pineridge Press, London.1980.

[3] Spalding.D.B. Numerical Modelling of Fluid-Mechanics, Heat-Transfer and Mass-Transfer Processes; A Lecture Course,Imperial College, Mech.Eng.Dept., Heat Transfer Section Report ref HTS/80/1, 1980.

[4] Spalding.D.B., Convective Heat Transfer,Fortschr. Verfahrenstech ., vol.15pp.55-56,1978.

[5] Schlunder E. U. On the Mechanism of Mass Transfer in Heterogeneous Systems – In Partticular In Fixed Beds, Fluidized Beds and on Bubble Trays, Chem. Eng. Sci., vol. 32, pp. 845 – 851, 1977.

[6] Abduganieva Z., Abduganieva Sh.Z., Zhurakulov M.M., Khudoinazarov Zh.B. Intensification of the process of removing moisture from the leather fabric of broadtail during the drying process. Achievements in science and education. Scientific - methodical journal. https://scientifictext.ru., №3(44), 2019. Ivanovo, st. Lezhnevskaya, 55, 4th floor. tel .: +7 (910) 690-5-09. http://scientificpublications.ru;

[7] Abduganiyev Z., Abduganiyeva Sh., Dzhurakulov M., Hudoynazarov Zh. Study of physical and mechanical characteristics of broadtail skins. LVI INTERNATIONAL CORRESPONDENCE SCIENTIFIC AND PRACTICAL CONFERENCE «INTERNATIONAL SCIENTIFIC REVIEW OF THE PROB-LEMS AND PROSPECTS OF MODERN SCIENCE AND EDUCATION» (Boston. USA. March 24-25, 2019).

[8] Lykov A.V. Heat and mass transfer. Handbook.-M.: Energy, 1978. - 479 p.

[9] Instructions for the primary processing of astrakhan firewood raw materials. - M .: State Publishing House, 1967.-12 p.

[10] Shelf for drying skins. Suvankulov Sh.K., Abduganieva Z. Patent No. 2015167 for an invention dated 30.06.1994.

[11] Abduganieva Z., Musurmonov A., Abduganieva Sh.Z. Drying of broadtail skins using a semi-cylindrical shelf for their fixation. "Agriculture and water economy of Uzbekistan" No. 12. 44-45 p. 2019.

[12] Abduganieva Z., Elmurodov A., Abduganieva Sh.Z. Study of the histoarchitectonics of the skin of broadtail skins with different drying methods. “Agro Science” №1. 65-66 p. 2020.

[13] Abduganiyev Z., Musurmanov A., Abduganiyeva Sh. Z. Increasing in the Surface of Moisture Evaporizatation from the Underkin Glue (Mezdro) Layer of Karakul Skin in the Course of Drying. International Journal of Progressive Sciences and Technologies (IJPSAT) ISSN: 2509-0119. © 2020 International Journals of Sciences and High Technologies http://ijpsat.ijsht-journals.org. Vol. 23 No. 2 November 2020, pp. 605-609.

[14] Abduganieva Z., Suvankulov Sh.K. Theoretical prerequisites for substantiating the parameters of heat-generating devices for drying broadtail. "Galiotekhnika", No. 5, 1994, pp. 70-71.

[15] Abduganiyev Z., Musurmanov A., Abduganiyeva Sh. Z. Karakol leather fixation drying supply. MODERN SCIENTIFIC CHALLENGES END TRENDS: a collektion of scientific works of the international 1 scientific conference Issue 3(37) Part 2 Warsav, POLAND, Wydawnictwo Naukowe “iScience” 7-8 april 2021. 187-194.