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INTENSIVE DRYING OF ASTRAKHAN SKINS

Abduganieva Shakhnoza Zayirkulovna
Doctoral Student, Samarkand Institute of Veterinary Medicine, Index 140103, Republic of Uzbekistan, Samarkand City, Mirzo Ulugbek street 77, index 140117, Republic of Uzbekistan, Samarkand City, Rudakiy street, Bakhtli hayot mahalla (neighborhood), House 6, Apartment 6, tel.: +99891-550-48-28, E-mail: nigora kr@mail.ru

Abstract

The article argues that astrakhan skins drying process, skin surface shrinkage and energy consumption reduction can be achieved by accelerating the drying process and increasing the evaporation surface, its achieving theory, moisture evaporating amount, the analytical relationship characterizing moisture evaporation from the astrakhan skin surface, the moisture amount passing through and evaporating on the drying skin layer surface (epidermis, dermis, subcutaneous cell), and to accelerate the astrakhan skins drying, it has been proved expedient to ensure that moisture evaporation from the astrakhan skin surface is twofold.

Keywords: Drying; astrakhan; skin; acceleration; dehydration; dry matter; humidity; isotherm; temperature; fixation; coefficient; spring; semi-cylindrical; shelf (shelf); base mesh surface; topographic.

Introduction

In drying process astrakhan skins to reduce the skin surface shrinkage and reduce the energy required for drying, by accelerating moisture release from the skin surface, i.e. accelerating the connection breakdown between dry matter and moisture in the astrakhan skin layer (epidermis, dermis, subcutaneous cell) can be achieved as multiplication result [1].

Materials and methods

The drying material dehydration acceleration, including the dry matter and moisture in the astrakhan skins, depends on various factors, in most cases depending on astrakhan skin drying process characteristics [1,2,8]. The moisture movement calculation scheme in astrakhan skin layers (epidermis, dermis, subcutaneous cells) during the drying process is shown in Figure 1.

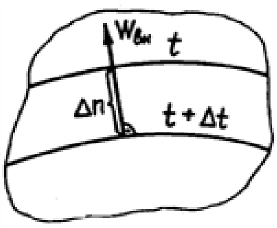


Figure.1. Scheme for calculating the moisture movement in astrakhan skin layers during drying.

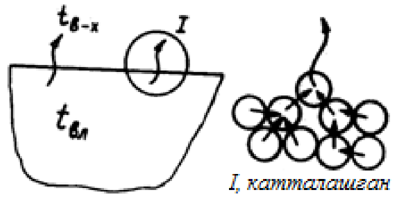


Figure.2. Moisture from the free surface of the astrakhan skin evaporation calculation scheme..

From the astrakhan skins we separate a small piece, indicated by the direction of the arrow of the shift of moisture. Moisture transfer in dried astrakhan skins occurs due to the difference between internal and external temperatures [3,4,5,8]. Typically, dried astrakhan skin is given heat from the outside and moisture moves from the inside out [6]. Passing two isothermal t and $t+\Delta t$ lines inside the dried astrakhan skin. As a result of connecting them with each other n normal we find the following connection:

$$\left[(t+\Delta t)-t\right]/\Delta n, \qquad (1)$$

this dependence gives the following product at $\Delta n \to 0$:

$$gradt = \frac{dt}{dn}, \qquad (2)$$

Taking into account the properties of astrakhan leather, the amount of elemental moisture moving inside the substance is determined by the following equation:

$$dW_{вн} = -R_{вн} \cdot gradt, \qquad (3)$$

here, $R_{ВН}$ is - specific filtration coefficient of moisture in the direction of the substance. kg/(sm^2 ^{0}C).

Assuming that the filtration of moisture in the direction of the skin passes through a surface of a certain thickness, we obtain the following equation:

$$W_{вн} = R_{вн} / \left[\delta\left(t_{вн} - t_{н,сл}\right)\right], \text{ кг/с}, \qquad (4)$$

here, δ is the thickness of the filtration layer inside the substance, m;

$t_{ВН}$, $t_{Н.СЛ}$ - the temperature of the inner and outer surface of the skin, which is dried accordingly,^{0}C.

Figure 2 shows a scheme for calculating the evaporation of moisture from the free surface of the astrakhan skin.

The amount of moisture evaporating from the free surface of the astrakhan skin was calculated as follows:

$$dW_{исп} = R_{исп} \cdot \Delta t \cdot dF_{исп,} \qquad (5)$$

here, $R_{исп}$ - coefficient of evaporation of moisture from the free surface of the astrakhan skin, kg/(sm^2 ^{0}C);

Δt is evaporation surface and ambient air temperature difference, ^{0}C.

Integrating the obtained expression, we obtain the analytical relationship that characterizes the acceleration of the process of evaporation of moisture from the free surface of the astrakhan skin:

$$W_{исп} = R_{исп} \cdot F_{исп}\left(t_{н\cdot сл} - t_{в}\right), \text{ кг/с}, \qquad (6)$$

here, $F_{исп}$ is moisture evaporating surface, m^2;

$t_в$ is ambient air temperature, ^{0}C.

The amount of moisture that passes through the astrakhan skin layer (epidermis, dermis, subcutaneous cell) and evaporates from its surface is equal to each other:

$$W_{вн} = W_{исп}, \qquad (7)$$

That's why, Solving equations (4) and (6) together, we obtain the following relationship:

$$W = R_{общ} \cdot F_{исп}(t_{вн} - t_в), \text{ кг/с}, \qquad (8)$$

here, $R_{общ}$ is the total coefficient of moisture output from the surface of the dried astrakhan skin.

The total coefficient of moisture output from the surface of the dried astrakhan skin is determined by the following formula, if the evaporation of moisture from the surface of the astrakhan skin is one-sided:

$$R^1{}_{общ} = \left(\frac{1}{R_{исп}{}^1} + \frac{\delta}{R_{вн}}\right)^{-1},, \quad \text{кг/с м}^2\,{}^0\text{C}, \qquad (9)$$

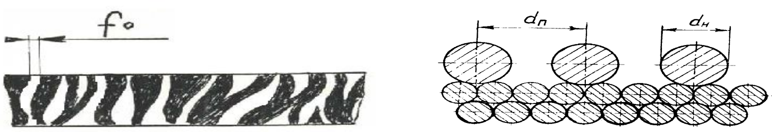
If the evaporation of moisture from the surface of the material (astrakhan leather) is on both sides, the given coefficient of moisture output is determined by the following formula:

$$R^{11}{}_{общ} = \left(\frac{1}{R_{исп}{}^1} + \frac{1}{R_{исп}{}^{11}} + \frac{\delta}{R_{вн}}\right)^{-1}, \text{ кг/с м}^2\,{}^0\text{C}, \qquad (10)$$

Fig. 3. Scheme and form of evaporation of moisture from the surface of the skin meat layer.
Figure 4 shows the scheme of the fixing (gluing) cassette.
Moisture evaporation is a prerequisite for the use of large-diameter yarns with a diameter of $d_н$ as gypsum as a moisture carrier. [7]. Evaporation of moisture from the skin surface is proportional to the evaporation of moisture from the specific surface of the hygroscopic material and is determined as follows:

$$L_{исп} = N_H \cdot \pi \cdot d_H м, \qquad (11)$$

here, $N_н$ is the number of threads on the elemental surface of the hygroscopic material, pcs.



а б

Fig. 3. The scheme of evaporation of moisture from the surface of the skin meat layer:
a - simple method; b is a method of fixation (gluing) to a hygroscopic material..

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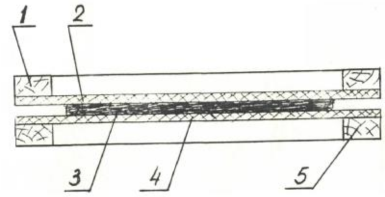

Fig. 4. Fixation of the skin meat layer to the hygroscopic material
Schematic of the cassette (glued): 1 - frame; 2 - 2,4 - upper and lower hygroscopic material; 3 - astrakhan skin.

The value of $N_н$ depends on the weave density of the yarns of the hygroscopic material and is determined as follows:

$$N_н = L/(d_н + d_п), pcs., \quad (12)$$

here, L is length of the analyzed plot, m;

$d_п$ - the distance between the threads on the elemental surface of the hygroscopic material, $d_п = (0,3…0,4)\ d_н$ mm.

Based on the results of the analysis, a hygroscopic material woven from yarns with a diameter $d_н$ = 0,05…0,07mm allows moisture to evaporate from the skin surface, but a hygroscopic material with a diameter ($d_н$ = 0,8…1,2 mm) can be used as this type of material is expensive.

Fig. 5. The scheme of calculation of the process of reduction of the thickness of the skin layer is shown.

The skin layer (epidermis, dermis, subcutaneous cell) can be considered as a set of spheres (spheres) with a diameter D [9]. During the drying of the skins, the diameter of the spheres decreases to a value of d. This in turn leads to a decrease in the thickness of the skin layer $\beta_н$ (initial thickness of the layer, before drying) to $\beta_к$ (final thickness of the layer, after drying). The distance between the points of contact of the spheres (spheres) is determined as follows:

$$A = D/\sqrt{3}, м \quad (13)$$

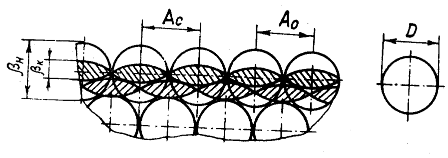

Fig. 5. Scheme for calculating the process of reducing the thickness of the skin layer.

Results and their analysis

This distance varies slightly during the drying process of astrakhan skins, if the skins are glued to a semi-cylindrical shelf (shelf), which allows the skin surface to remain in dimensions close to the initial, pre-drying surface. In this case, the deformation is mainly formed by the thickness of the skin layer, which changes relatively significantly during the drying process [9]. Figure 6 shows the scheme of multiplication by fixing (gluing) the evaporating surface of moisture from the surface of the skin layer to the semi-cylindrical shelf (shelf) with hygroscopic material.

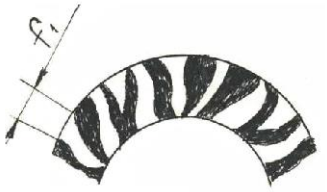

Fig. 6. The scheme of reproduction by fixing (gluing) the evaporating surface of moisture from the surface of the skin to the semi-cylindrical shelf (shelf) with hygroscopic material.

During the drying process of astrakhan skins, if the base surface is glued to one side of the semi-cylindrical shelf (shelf), tension is created between the individual layers of skin, which can lead to cracking of the product - astrakhan skins and other negative consequences. Therefore, in the process of drying astrakhan skins, it is advisable to dry the base surface on a semi-cylindrical shelf (shelf) in such a way that the astrakhan skins are glued on both sides. Also, when the skins are dried in this way, the hygroscopic material on the semi-cylindrical shelves (shelves) of the base surface ensures that the skins are fixed (sticking) and dry, increasing the evaporation surface of moisture from the skin surface, which accelerates the drying process. $R^{11}_{общ} > R^{1}_{общ}$ Comparing the expressions (9) and (10) we see that $R^{11}_{общ} > R^{1}_{общ}$, i.e. it is expedient to use semi-cylindrical shelves (polka) in drying astrakhan skins to ensure that moisture evaporation from the skin surface is two-way to accelerate drying of astrakhan skins. The use of semi-cylindrical shelves in the drying of astrakhan skins from expressions (11), (12) and (10), along with improving the drying surface and quality, ensures that the dried skin is fixed and stretched over the entire surface, which reduces the shrinkage of the skin surface during drying.

Conclusion

In conclusion, the skin at the top of the semi-cylindrical shelf (polka) is under great pressure relative to its edge parts, making it flat. This, in the process of drying the skin, leads to every skin surface shrinkage in its various topographic parts. In order to reduce this unevenness, the change in force $F_н$ should be limited to (0,6…0,8) $\mathbf{F_п}$, for this it is necessary to ensure that $\alpha = 50^0$, $L_ш$ = 0,6m and the radius of the base mesh surface of the semi-cylindrical shelf (shelf) is R = (0,23…0,30) m. As a result, it is possible to achieve a tightening of the dried skin, a reduction in the shrinkage of the skin surface during the drying process.

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