Research of Quality Indicators of Fur Plates from a Fur Flap

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Abstract: Much attention is paid to the issues of waste-free use of the area of skins of fur semi-finished products of various types. The share of costs for fur and leather semi-finished products in the cost of fur and leather products reaches 80–90%. Therefore, their economical use plays a very significant role in reducing the cost of products. Increasing the utilization rate of fur semi-finished products and natural leather materials due to the maximum use of the flap and low-grade raw materials plays an important role.The use of an expensive semi-finished product and manufacturing methods, a large variability of physical and mechanical properties, determined by the natural and biological characteristics of animals, require comprehensive research to develop and form the principles of domestic design of fur products.

Keywords: fur clothing, fur semi-finished product, fur trimming, silhouette, combining fur with various materials.

1. Introduction

The efforts of manufacturers of fur and leather products are aimed at reducing material losses and rational use of waste. To do this, they plan to manufacture small leather goods, use patchwork technology, combined cutting according to rational layouts of patterns, use various types of equipment that provide low-waste cutting technology. However, it is not possible to achieve full utilization of waste. A significant part of them has not yet found application and are taken to dumps, which, in addition to material losses, leads to environmental pollution.

It should be emphasized that the term "waste" applied to parts of skins and flaps, especially such valuable semi-finished products as mink, sable, arctic fox, fox, astrakhan fur and other species, is not adequate to the value that they acquire after the manufacture of various fur products. The most valuable waste products are: tails from the skins of a silver-black fox, sibodushka (Colored fox), platinum and snow fox, blue and white fox, sable, marten, mink, Siberian weasel and lynx skins; paws from fox and arctic fox skins of all varieties, paws and neck parts of astrakhan, broadtail and birch fur, paws from mink, sable, lynx skins; a furrier's flap of valuable types of furs, astrakhan fur, astrakhan fur and broadtail.

The main reason for the incomplete use of waste generated in the process of cutting fur semi-finished products and natural leather materials is that they have a complex irregular shape and are characterized by a wide variety in size and configuration. This is due to the influence of the type of semi-finished product, the configuration and size of the skins, their quality, cutting methods and other factors. Another feature that complicates the process of processing waste of fur semi-finished products (FSP) and natural leather materials is their belonging to different topographic areas of skins. Depending on this, the waste has different indicators in terms of the degree of density and height of the hair, the direction of the hair and the thickness of the flesh, which greatly complicates their use for the manufacture of high-quality products. As a result, more than 50% of natural fur waste at fur factories remains unused and is an important resource conservation reserve [1-3].The use of an expensive semi-finished product, and manufacturing methods, a large variability of physical and mechanical properties, determined by the natural and biological characteristics of animals, require comprehensive research to improve the design methods of fur products from a flap.

With the artistic design of fur products from waste, complete consistency must also be achieved between its physical, mechanical and aesthetic properties, the terms of obsolescence, which means that the synchronization of its aging in all parameters must be ensured.

For the rational use of furrier waste, designers have successfully used such innovative methods of flat decoration of skins, such as inlay, perforation, appliqué, blotches, fringe trim, decoration with ornaments, and embroidery on the leather fabric of the skin [2]. Such methods of innovative design make it possible to transform the surface of the fur, improve its aesthetic, operational quality indicators, increase the usable area of expensive fur raw materials and create a fur product that meets the requirements of modern design, contribute to the targeted use of a fur flap or low-grade semi-finished product, attracting buyers to the least valuable types of fur. When using such methods, many firms make changes in the technological schemes of raw materials processing, taking into account the latest recent advances [3].

The successful (effective) application of innovative methods for the design of fur products from furrier production waste should be achieved with full consistency between its physical, mechanical and aesthetic properties, the terms of obsolescence, visual lightness without compromising the functionality, efficiency and expediency of their production, which means there should be its aging is synchronous in all parameters. This implies a decrease in the weight of the product, a 2-fold reduction in the amount of semi-finished fur, a simplification of manufacturing methods with a parallel reduction in the cost of products, unification of design methods and an increase in the aesthetic value of finished products.

The technological features of the thread connection of the cut skins and flap are associated with the properties of the PMF, and mainly with the thickness, density, plasticity, elasticity and strength characteristics of the leather tissue of the skins. The level of performance of both furrier and sewing work is largely determined by the quality of machine and manual operations, which is formed at the stages of selection of sewing needles, threads and setting the parameters of thread connection of skins and sewing parts.

Consequently, the improvement of the technology of obtaining fur plates from a flap makes it possible to improve the quality of the use of fur semi-finished products, expand the range of products, produce products that are in demand on the modern market and have a wide range of applications.

The aim of the study is to increase the efficiency of using waste of fur semi-finished products formed during cutting of the main products. The object of research is a fur flap of various sizes from especially valuable types of semi-finished products.

This article presents materials for the manufacture of fur clothing from furrier's waste. The collection of information was carried out through an analytical review of the literature and search in electronic databases, including PubMed, Web of Science [4].

2. Experimentalpart

Waste classification. In this work, the manufacture of fur plates from the flap was carried out according to the traditional method: sorting, cutting off and fitting the flap in size, stitching the strips into plates of specified sizes and shapes (rectangular, square, trapezoidal, etc.), moistening and straightening, leveling each row and eliminating wrinkles, drying and traditional finishing operations [5]. For the processing of fur waste, a flap of highly valuable parts of the skins of fur-bearing animals: mink, muskrat, astrakhan and broadtail were taken.

The analysis of the waste of a fur semi-finished product (FSP) was made on the basis of a study of the literature and experimental sorting of a karakul fur flap in the conditions of OOO “Original Textile and Print” in Tashkent. The object of research is the FSP waste remaining after cutting fur skins in the production conditions of domestic enterprises, put up for sale in the trade network of Tashkent. This is a waste of mink fur, astrakhan fur, rabbit, nutri. The waste was very diverse in size and shape, type of fur, color, quality of manufacture, density and other indicators.

In accordance with the technology for the production of fur products [6] the flap was pre-sorted into furrier, foot and inter-patch. Within each group, the flap was subdivided according to the type of fur, color and height of the hairline, according to its shape and configuration (lobe, transverse, rectangular, conical, triangular, etc.).

The study of FSP waste showed that they are subdivided according to the types and sizes of fur as follows (Fig. 1):

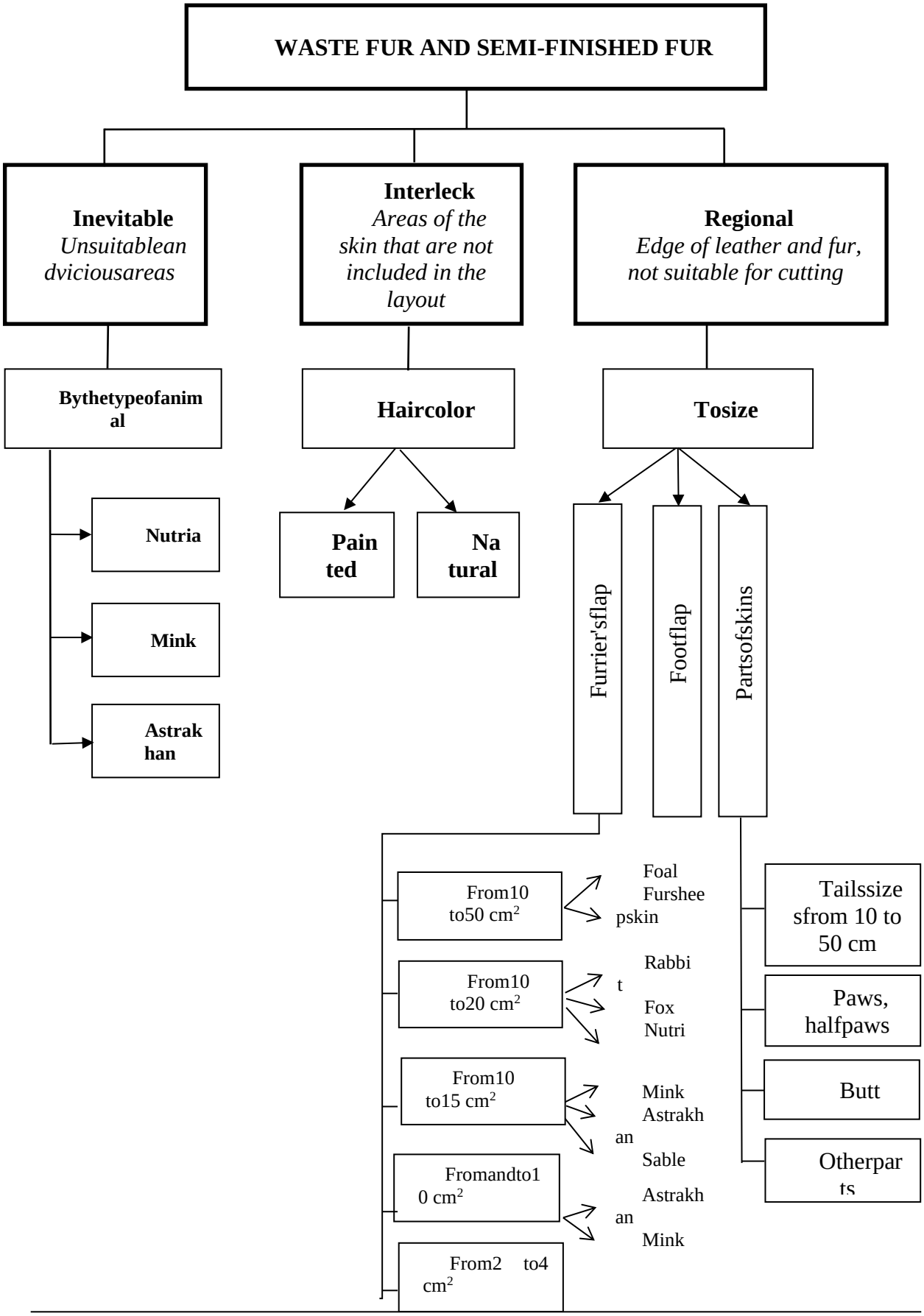
- tails from mink skins: long - more than 15 cm, medium - from 10 to 15 cm, short - from 7 to 10 cm;

-tails, the length of which is less than 7cm and the width is less than 1cm, are referred to as a foot flap. This also includes tails with defects in the hairline and skin tissue on an area of more than 50%;

- paws of karakul, smushka, yachobab skins with a length of more than 16 and a width of at least 2 cm; lamb with a length of more than 14 cm; minks more than 7 cm long, at least 2 cm wide; foxes of all varieties more than 15 cm long and at least 2 cm wide;

- paws of a cone-shaped shape and paws, the sizes of which are less than those indicated above, are referred to as semi-paws, paws of mink skins less than 7 cm long - to a flap;

- half-paws of karakul, smushka and jacobab skins from 8 to 16 in length and at least 2 cm wide; lamb with a length of 6 to 14 cm; foxes of all varieties from 9 to 15 cm long;



- half-legs, the length of which is less than those indicated above, are referred to as a flap;
- barrels of rabbit, fox skins, sheared and dyed with an area of at least 20 cm2 and a width of at least 2 cm.

The rest of the skins are not subdivided by area. It is allowed to double the size of the furrier's flap in the presence of defects in the hair and skin tissue [7].

A foot flap includes a flap whose area and width are less than the above dimensions. Cutting from the skins of astrakhan, broadtail, as well as a furrier's flap, which has defects in the hairline and skin tissue, is referred to the foot flap.

Manufacturing of plates. Currently, there are various methods of making fur skins and plates [2,8]. The selection of the flap into the plates was made from homogeneous groups of fur, taking into account the requirements for fur clothing [2,9,10].

The traditional way of using FSP waste for clothing is the manufacture of fur plates collected from the largest fragments of fur skins (mainly peripheral areas and inter-pattern outlets), the shape and size of which depend on the waste used. A flap of most of the semi-finished fur product is cut into pieces that have the shape of a square, rectangle, triangle, cone, as well as into side and transverse strips. In this case, the waste should be of high quality, with a uniform hairline, the direction of which must be taken into account when forming a fur plate.

The flap of the astrakhan-merlushk group was sorted by the type of curl. Such a flap is cut into pieces of any shape. At the same time, bald patches, defects of the hairline and skin tissue were removed. The skin of these broadtail skins is quite thin. Therefore, in products made of broadtail, it is very important that the seam is strong, does not damage the thin leather fabric, looks neat and is not noticeable from the face.

Innovative methods for the design of semi-finished fur products from waste require aesthetic harmony of color solutions, the texture of the fur and its lightness of the plates on the product, therefore, when selecting a flap, it is necessary to take into account the type of fur, features of the hair and leather fabric, linear dimensions.

Karakul has more opportunities in the selection of skins by color and texture, since the process of stitching parts of skins does not affect the appearance of the product - thanks to the curl of hair on the front side of the product, the seams are completely invisible.

When making the plates, the flap was cut off by obligatory alignment in width using the jointing method. The direction of the hairline is lobar from top to bottom. The flap was placed in rows in the plates, and between the pieces, joining made of soft leather or suede was inserted. The width of the jointing may vary. The largest pieces are located in the lower rows with a gradual transition to thinner ones in the upper ones.

To assess the quality of harvested fur plates from waste fur skins, experimental studies were carried out on various semi-finished products of FSP. The following properties of the leather tissue of the plates were experimentally determined: density, thickness, heat retention, strength properties, elastic-plastic properties and vapor permeability [11-12].

Strips of the largest possible size were cut from the furrier's flap and parts of the skins. Then the strips were connected with pieces of a skin flap 2.0 cm wide. Cutting, stitching of parts of skins, production of seams and plates from natural fur waste was performed using a furrier machine, a furrier's jamb knife, a metal comb «comb», a cutting board, scissors, tailor's chalk, a measuring ruler, patterns, cargo, and other tailors tools by hand.

In fig. 1 shows the process of the stage-by-stage manufacture of plates from the fur waste of the astrakhan-merlushkgroup. In this case, the size of the waste in width can be different - from 2 cm to 10 ... 15 cm.

In total, 2 types of plates were prepared for the experiment: plates made of a fur flap, plates in combination with natural leather, made by the «jointing» method (Table 1).

The selection and preparation of samples for the experiment was carried out in accordance with [13]. The thickness, density and weight of the samples were measured at 3 points and the average was taken in accordance with GOST.

The flap was joined on a single-thread chain overcasting machine using sewing needles, the selection of which is determined by the thickness and density of the leather fabric. For sewing, a 10-B class furrier machine (Russia), JT-4-5A from JATI (China) was used. The strength and appearance of the seam also depend on the linear density (trade number) of the sewing thread.

To make machine stitches on furrier machines, the selection of the needle and sewing thread was made in accordance with [14]. For sewing the flap, furrier's threads for sewing fur products «COATS Gral» No. 180 were used.

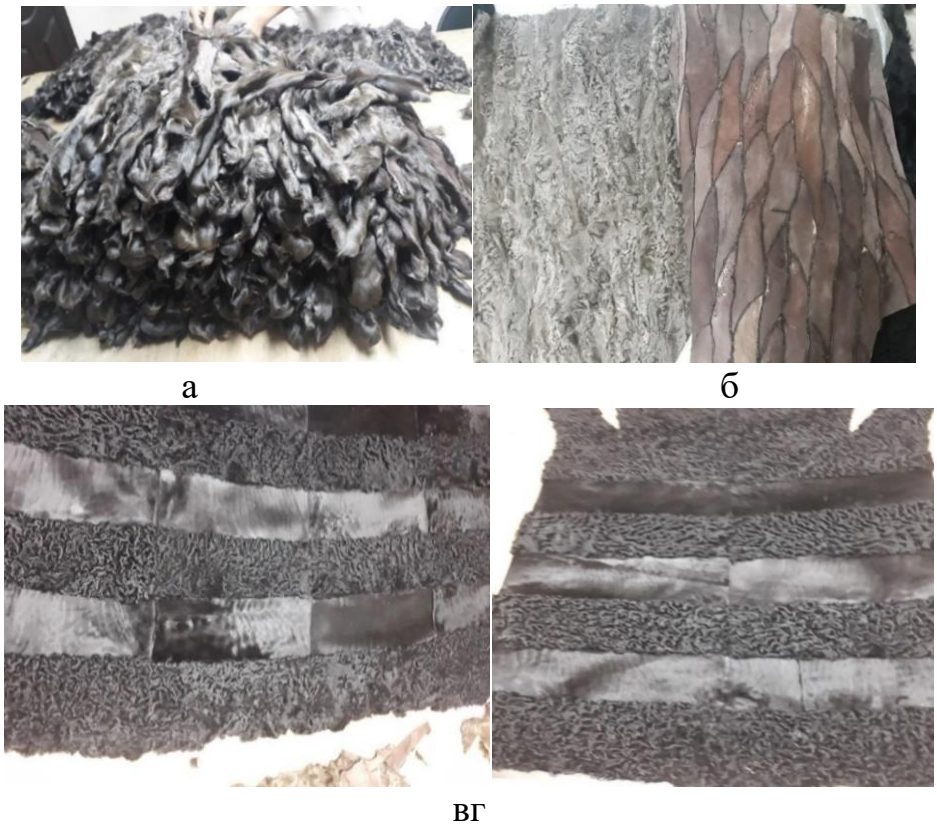


Fig. 1. Classification of waste of fur semi-finished products

The number of stitches per 10 mm of a line varies from 6-7 stitches for a semi-finished product with a thin leather fabric to 4-5 and even 3-4 for a FSPwith a thick leather fabric.When joining a flap made of small and medium sized skins, fine and medium sized skins, the furrier suture height did not exceed 1.0 mm, and for large and thick skins it did not exceed 2.0 mm. The number of stitches per 10 mm of a line varies from 6-7 stitches for a semi-finished product with a thin leather fabric to 4-5 and even 3-4 for a FSPwith a thick leather fabric.

To increase the dimensional stability, the finished fur flap plates were preliminarily duplicated with thin cotton coarse calico. At the same time, the coarse calico was pre-decotated, the connection of the gasket into the package was made using a thread method.

To assess the quality of the plates harvested from waste fur skins, experimental studies were carried out on various semi-finished products of the FSP. It is known that the quality of FSP is determined on the basis of the properties of the hair, leather tissue and skins in general. In the case of determining the quality of the manufactured plates, we determined the integral indicators of the quality of the plates.

- thickness; [15].
- density; [16].
- heat retention; [17].
- vapor permeability; [18].
- elastic-plastic properties; [19].
- strength; [20].

Table 1

Samples of fur plates made by the "Sewing" method

T/p	**Thetype of FSP**	**Front view**	**Seamy side**
1	**Karakulcha + Astrakhan**		

2	**Karakulcha+ mink**		
3	**Nutria + leather**		
4	**Mink + leather**		

Experimental studies were carried out in the TITLI certification laboratory according to standard methods. The results of experimental studies are given in table. 2 and 3.

Table 2

Characteristics of experimental samples of fur flap plates

№	Typeoffur	Density, kg/m3	Furthickness, mm			Weight, gr		
			Thick-ness, mm	Root-mean-square devia-tion	The coefficient of varia-tion, V	Avera-gemass, gr	Root-mean-square devia-tion	The coefficient of variation ,V
1	**Astrakhan**	**0,972**	**1,54**	**0,27**	**17,5**	**1,49**	**0,07**	**4,7**
2	**Karakul+ lining**	**1,037**	**1,84**	**0,21**	**11,4**	**0,17**	**0,04**	**23,5**
3	**Broadtail**	**0,414**	**0,39**	**0,04**	**10,2**	**0,046**	**0,001**	**3,9**
4	**Broadtail + lining**	**0,530**	**0,64**	**0,05**	**7,8**	**0,067**	**0,004**	**6,0**
5	**Nutria**	**0,974**	**2,10**	**0,23**	**11,0**	**0,163**	**0,04**	**21,5**
6	**Nutria + lining**	**1,044**	**1,93**	**0,07**	**3,7**	**0,168**	**0,03**	**18,7**
7	**Mink**	**0,485**	**1,84**	**0,10**	**5,3**	**1,09**	**0,09**	**8,3**
8	**Mink + lining**	**0,556**	**1,93**	**0,07**	**3,7**	**0,193**	**0,02**	**10,4**

Table 3

Tensile test results of fur plates

№	Typeoffur	Breakingload, H		Elongationatbreak, %	
		Along	Across	Along	Across
1	**Astrakhan**	82	66	22	20
2	**Karakul+ lining**	187	22,9	72	20,2
3	**Broadtail**	**88**	**79**	**29**	**26**
4	**Broadtail + lining**	**59**	**65**	**26**	**27,5**
5	**Nutria**	**143**	**126**	**51,1**	**45**
6	**Nutria + lining**	**87**	**235**	**7,1**	**6,6**
7	**Mink**	**177**	**174**	**50,9**	**50**
8	**Mink + lining**	**167**	**136**	**6,8**	**40**

Methods for determining vapor permeability. Vapor permeability is the ability of a leather fabric to transmit water vapor from an environment with a higher air humidity to an environment with a lower humidity. Vapor permeability, like air permeability, is one of the characteristics of the hygienic properties of leather fabric.

The determination of the vapor permeability of the leather fabric of a fur semi-finished product is based on the creation of different elasticity of water vapor on both sides of the test sample and the establishment of the amount of water vapor passing through the unit area of the sample and the establishment of the amount of water vapor passed through the unit of time. Technical scales, desiccators, special metal cups 45 mm high and 55 mm in diameter, distilled water, concentrated sulfuric acid (density 1.84). Sampling was carried out in accordance with GOST R 52958-2008. From each sample, 2 samples were cut out, in the form of a circle with a diameter of 55 mm (with a diameter of the working part of the sample 36 mm).

Water vapor permeability (P), expressed in milligrams of moisture passed through a unit area of the sample (1 cm²) per unit of time (1 h), was calculated by the formula (9) [19]:

$\Pi=m/(t*\pi r^2)$

Where m - decreased the mass of the glass with the contents for 6 hours, mg;

t is the duration of the experiment, h:

π is the area of the working part of the sample, see

Table 4.

Results of testing the permeability of fur plates

Sample number	Name of samples	Samplethickness, in m	Density, kg / m3	Relative vaporpermeabilityin %	Water vapor permeability in mg / cm h	Heatretention, %
1	Astrakhan	1,54	0.972	4,3	0,0213	63.90
2	Karakul+ lining	1,84	1.037	5,3	0,0262	63.37
3	Broadtail	0,39	0.414	4,3	0,0213	61.30
4	Broadtail + lining	0,64	0.530	5,3	0,0262	59.80
5	Nutria	2,10	0.974	4,6	0,0246	60.70
6	Nutria + lining	1,93	1.044	3,6	0,0180	60.23
7	Mink	1,84	0.485	5,9	0,0296	50.70
8	Mink + lining	1,93	0,556	5,3	0,0080	50.10

3. Results and Discussion

According to the data obtained (Table 2), the thickness of the fur plates varies depending on the type of flap and overlap with lining, and becomes larger in samples with lining. It is known that the uniformity in thickness and weight of leather and fur samples varies considerably - up to 40% [8,21]. The measurement data for the thickness of the samples show a large scatter of values, which is explained by the fact that the skin scraps were collected from various topographic areas of the fur.

The main indicators of the physical and mechanical properties of fur skins are the strength and elongation of the skin tissue to break, which depend on the histological structure, thickness, density, as well as the processes of canning, dressing and dyeing, and largely determine the quality of furrier work.

A feature of natural fur is a significant anisotropy of properties in the area of skins and in thickness [21], suggesting a high variability of changes in thickness and breaking characteristics in topographic areas. The deformation properties of skins depend on the type of stretching of the material during the dressing process (uniaxial, biaxial, planar or spatial), and a sharp difference in properties in mutually perpendicular directions under uniaxial stretching indicates anisotropy of the properties of leather tissue.

The data presented indicate a decrease in the strength of the plates from skins with thick leather fabric (samples from mink and muskrat) to skins with thin leather fabric (astrakhan and broadtail). The low strength of leather fabric and skins determines the low strength of the furrier's seam, which requires the mandatory use of

reinforcing materials in the process of making them. To increase the strength of the plates, the flap must be selected not only uniform in the height of the hairline, but also in the thickness of the skin tissue.

Elongation of the leather fabric at break determines the plasticity of the fur skin, in the absence of which deformation and shrinkage of products occurs, and with excessive plasticity, fur products lose their shape due to residual deformation of areas subjected to intense stretching [8].

A comparative analysis of the results of measuring the elongation indices of experimental samples of plates made of fur flap of various types of fur shows a significant decrease in the plasticity of the skins after their replanting on the lining (samples of mink and muskrat) both along and across the samples of the plates. It is recommended to use skins with a greater plasticity and thickness of leather fabric in the manufacture of products of a certain shape, in which molding of parts is required, such as a collar, sleeves and details of a fur hat. For them, it is advisable to use plates without lining or to strengthen their structure after stretching the skin.

The heat-retaining ability of the plates, in fact, is the property of the material to maintain comfortable thermophysical conditions for wearing outerwear. This indicator characterizes the ability of the plates to maintain a temperature of -36.6 ° C in the working area of the device. As can be seen from table 4, the heat-holding capacity of karakul and nutria are maximum and at the same time there is a directly proportional dependence of this value on the density and thickness of the plates. It can also be seen from the table that duplicated plates have a heat retention rate of 1-2.5% more than conventional plates.

The experiments carried out to determine the vapor permeability of the samples showed that all samples have a certain level of vapor permeability and this is important for clothing materials. Samples of the astrakhan group have this indicator by 15.0% less than a semi-finished product from fur. It should be noted that the duplication of the plates with a lining material has a different effect on the vapor permeability of the plates.

4. Conclusion

Thus, an important reserve for increasing the profitability and efficiency of leather and fur production, reducing losses from cutting expensive fur raw materials and expanding the range of products is the targeted use of fur waste by applying innovative design methods [22, 23] and improving the technology of obtaining plates from a flap. To increase the strength of the waste connection, when selecting a flap, one should take into account the height of the hairline and the thickness of the fur skin. In order for the obtained plates to have a set of useful properties and to be in equilibrium in terms of plasticity and strength, it is better to duplicate them with a thin hot-melt knitted fabric. This will improve the elastic properties of fur plates, increase the degree of their use not only for flat, but also molded, requiring a certain shape of clothing parts. [24]

Failure to comply with the parameters of the thread connection, improper selection of needles and threads lead to needle breakage, thread breakage, the formation of cuts, skipping in the seams, tightness of the stitch, uneven stitches along the length of the line, as well as the appearance of defects that appear during wear and are hidden - rupture of the leather fabrics along the seams and a violation of the integrity of the stitching along the seams.

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