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Creation of a Technology for Filling the Skin with Effective Protein - Polymer Compositions

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Abstract:
The article describes the use of instead of an inorganic substance in the process of filling the production of leathers for the bottom of shoes with water-soluble local polymers, in which by reacting with functional groups of collagen, as a result of which these polymers are transformed on dermal fibers into water-insoluble compounds, which leads to an increase in the thickness of peripheral patches of skin.

Keywords:*collagen, skin, fillers, water-soluble polymers, polymer composition, hydrolyzed polyacrylonitrile.*

I. INTRODUCTION

In leather and fur production, raw materials of biological origin are used, the main component of which are protein substances, or proteins - collagen of the dermis and hair keratin. [1].

In the leather industry, low molecular weight inorganic substances are widely used as a filler. However, during operation, these inorganic substances under extreme conditions easily migrate from skin products, are extracted, washed and the skin becomes loose, empty and brittle.

The introduction of high molecular weight compounds into the skin during the filling process leads to their reaction with collagen functional groups, as a result of which these polymers are transformed on the dermis fibers into water-insoluble compounds, which leads to an increase in the thickness of peripheral areas. In this case, structuring occurs due to the transverse bonding of the collagen molecular chains.

In this regard, we have created a technology for filling leathers with effective protein (based on non-standard leather raw materials, tanned goblets and other wastes) and polymer compositions with improved properties. [2]

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II. Materials and Methods

To create a composition, we conducted experiments to obtain a protein hydrolyzate from non-standard leather raw materials and waste from this production by exposure to acid (H_2SO_4, HCl). A digester was used to obtain a protein hydrolyzate. Water was collected into the digester with an LCD (liquid coefficient) = 8, then it loaded the required amount of non-chrome leather waste. Then added sulfuric acid in an amount of 20-30 g / l., With constant stirring with a mechanical stirrer. Then the temperature was gradually raised to 80–900 ° C. The hydrolysis of nonchromic raw waste and non-standard raw materials was carried out for 4 to 8 hours.

In this case, the main part of the skin - raw dermis in the presence of sulfuric acid and vigorous mechanical stress was completely destroyed, and a viscous aqueous solution formed. Wool due to its resistance to acid exposure remained unchanged. After settling, the resulting mixture was filtered from wool and various mechanical impurities. The filtered viscous solution was separated and the fat was separated, resulting in a protein hydrolyzate.

III. Results and Discussion

Based on the protein modifier developed by us, from non-chromed leather wastes, collagen-polymer derivatives, in particular protein-polymer compositions, were obtained from local raw materials. As you know, at present, in production conditions, when filling leathers, imported expensive starting products are used, and this is not economically feasible. In this regard, to fill the skins, we obtained and used protein-polymer compositions with locally produced hydrolyzed polyacrylonitrile. The composition of the obtained protein-polymer composition is shown in table 1.

Table 1.The composition of the protein-polymer composition for filling the skin

№	Name of source components	Mass part	kg
1.	Protein hydrolyzate	40	150
2.	Hydrolyzed Polyacrylonitrile	30	112,5
3.	Technical ammonia water	3	11,25
4.	Surfactant (OP-10, OP-7)	2	7,5
5.	Water condensate	25	93,75
	Total	100	375

Protein-polymer composition was prepared as follows. In a reactor equipped with a mechanical stirrer 40 mass. including 52,3% protein hydrolyzate of chromium chips, 30 mass. including hydrolyzed with sodium hydroxide polyacrylonitrile with a degree of saponification of 40%, 3 wt. including ammonium hydroxide - 25%, 25 mass. including water condensate and 2,0 mass. h non-ionic surfactant (OP-10) with vigorous stirring was heated with compressed steam through the jacket of the reactor to a temperature of 55-70 °C for 3-4 hours. As a result of the reaction, a homogeneous protein-polymer composition with a dry residue of 20,4% and a pH of 8,2 was formed. According to this method, in a production environment, the yield of the protein-polymer composition was 375 kg.

Further experiments were aimed at using the obtained protein-polymer composition in skin filling technology. For this, after the tanning process, the chrome semi-finished product was loaded into the drum, where the filling process was carried out. At the stage of the filling process, fillers were fed through the hollow axis of the drum at a rate of 100 m2. The composition of the filler is shown in table 2.

Table 2.The composition of the protein-polymer composition for filling the skin

The name of the fillers	Expense on 100 m^2			
	By known technology, control		Experienced technology	
	%	kg	%	kg
MX-30	2,5	2,49	1,3	1,29
BN-30 K-2	0,6	0,51	0,2	0,17

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Protein-polymer composition	-	-	2,5	1,18

After adding fillers, the LC = 1,0-1,2 was adjusted, and the drum was rotated at a temperature of 60-65 °C for 45-60 min. After filling the semi-finished product, all finishing processes and operations were carried out according to the production method.

Then we studied the physical and mechanical properties of the finished experimental and control skins. The data obtained are presented in table 3. It can be seen from the table that in the experimental samples the physicomechanical properties of the leathers do not deteriorate compared to the control ones. Organoleptic evaluation of the skin showed that the skin becomes soft, full, especially in loose areas. In this case, the physical and mechanical properties throughout the area become the same. The skin developed using protein-polymer compositions are well filled, especially in the peripheral areas, have a silky front surface.

Table 3.Physico-mechanical properties of experimental and control leathers treated with a protein-polymer composition

The name of indicators	Experienced		Control	GOST 292277–92
	1 option	2 option		
Tensile Strength, kgf/mm	2,41	2,43	2,23	n/m 2,0
Relative extension, %	28,5	28,3	29,9	n/b 35
Moisture content,%	55,9	56,1	51,4	n/b 65
Stiffness, kg	48,6	48,7	47,4	n/m 45

This shows that the obtained protein-polymer composition can be used in a certain amount instead of the expensive imported components of the skin filling compositions.

When developing methods for filling the skin with protein compositions in experiments to improve the fullness and improve the quality of the finished skin, the semi-finished product after tanning was treated with sodium naphthenate (mylonaphth) 1,0-4,0% by weight of the skin, followed by retanning with a protein hydrolyzate.

The hydrolyzate was obtained from the leather waste of the shoe, saddle saddle and leather for the bottom of shoes using vegetable tanning agents, chromoaluminosynthanning tanning and chromaluminocarbamide-urotropin compounds. Sodium naphthenate contributed to better diffusion of the protein hydrolyzate into the skin without formation of perfume. Processing was carried out in the following ways:

Option 1. The skin after planing and the first washing for 45 min was treated with sodium naphthenate 1.0% by weight of planed leather at a temperature of 30-35 °C and LC-0,5 (liquid coefficient). Then, a protein hydrolyzate from tanning waste products with a pH of 0,5 with a dry residue of 2,0% of planed leathers was introduced into the same solution. All this was placed in a drum that rotates for 60 minutes. Then, a neutralizer — sodium bicarbonate was introduced at the rate of 1,0–1,3% of the weight of the skin and the drum was rotated for 30 minutes. After neutralization, washing, dyeing and fatliquoring followed.

Option 2. Everything is as in option 1, only skin treatment was carried out with sodium naphthenate 2,0% by weight of planed leathers.

Option 3. Everything is as in option 1, only skin treatment was carried out with sodium naphthenate in an amount of 3,0% by weight of the skin.

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Physico-chemical data, indicators of leather samples treated with the new method 1 according to options 1, 2, 3 and the control are presented in table 4.

Table 4.Physico-chemical and mechanical properties of experimental and control skins treated with protein hydrolyzate

The name of indicators	Control processing	Experienced Options			GOST 29277-92
		1	2	3	
Moisture%	12,9	13,03	12,25	12,32	12,0-17
Fat%	3,20	3,30	3,91	4,0	3,1-4,4
Moisture content,%	62,3	56,4	54,9	55,1	n/b 65,0
Vapor permeability,%	42,4	41,3	40,3	40,5	n/b 53,0
Tensile Strength, kgf / mm	2,06	2,39	2,45	2,51	n/m 2,0
Relative extension, %	29,2	26,8	26,5	26,1	n/b 35,0
Stiffness, kg	49,0	46,8	46,8	47,9	n/m 45,0

IV. CONCLUSIONS

The table shows that the use of the proposed method of processing leather with subsequent retanning and filling with a protein hydrolyzate obtained from leather wastes, improves the chemical, physico-chemical and other properties of loose peripheral skin areas. Thus, the density of the peripheral areas increases and thereby the fullness is improved and the quality of the treated skin is improved.

V. REFERENCES

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