ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 11 , November 2020

Analysis of Physical and Mechanical Properties of Skin Oil Based on Secondary Petroleum Products

K.RKhujakulov, A.M Narzullaeva, Z.X Rayimov, R.N Niyozova, N.Q Jamilova, B.O Raxmonov

Doctoral student of the Bukhara Engineering Technological Institute, Bukhara, Uzbekistan.

Doctoral student of the Bukhara Engineering Technological Institute, Bukhara, Uzbekistan

Assistant of the Department of Chemical Technology of Organic Substances, Bukhara Engineering Technological Institute, Bukhara, Uzbekistan

Assistant of the Department of Chemical Technology of Organic Substances, Bukhara Engineering Technological Institute, Bukhara, Uzbekistan

Assistant of the Department of Chemical Technology of Organic Substances, Bukhara Engineering Technological Institute, Bukhara, Uzbekistan

Student of the Department of Chemical Technology of Organic Substances, Bukhara Engineering Technological Institute, Bukhara, Uzbekistan

ABSTRACT: The article deals with the physicomechanical properties of leather treated in the process of fattening with fatty acids synthesized on the basis of secondary oil waste were studied. It has been found that fatty acids are absorbed not only into the upper part of the skin, but also into the inner layer of the dermis and between collagen tissues. As a result, it was found that the physical and mechanical properties of the skin fattened with these substances improved. It has also been found to form a strong bond between collagen tissues.

KEY WORDS: structure, dermis, reduces the forces, resistance, penetration, irreversible shrinkage, semi-finished product, hydration process, loss of moisture, collagen structure, fatty substances.

1. INTRODUCTION

Today, for the production of high-quality finished leather, it is important to use lubricants that exhibit complex properties in the lubrication process. Vegetable and animal fats are valuable food products, so their non-technological use is possible to minimize the impact of the leather industry on the environment and create waste-free technologies in the industry. Scientific research is needed to obtain cheap and high-quality lubricants that are not inferior in technological properties to oils and lubricants.

II. MATERIALS AND METHODS.

As you know, one of the most important consumer properties of chrome leather is that they retain their properties under the influence of operational factors. Fatting of semi-finished products made of leather and fur is the process of adding fatty materials to the skin, which are adsorbed on its surface structural elements, as well as are located and separated between them and increase the flexibility, softness and high moisture resistance of the product. At the same time, fatliquoring materials increase the mutual displacement of structural elements, facilitating orientation under deformation. As a result, the dermis has high strength and elasticity. The technological process of making semi-finished products from leather and fur is built in such a way that it always precedes the drying process. Fatty substances included in the dermis are located between the structural elements of collagen, preventing the interaction of active centers of neighboring protein elements and the formation of excessive cross-links. All this in the structure of the dermis reduces the forces of resistance to penetration, and also leads to irreversible shrinkage of the semi-finished product. The greatest penetration into the dermis occurs during the hydration process, with the loss of moisture present in the softest capillaries in the collagen structure. The presence of fatty substances in these capillaries prevents them from sticking to the walls, which means irreversible shrinkage. Thus, the uniform distribution of fatty materials in the

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 11 , November 2020

structure of the dermis provides penetration, reducing shrinkage, that is, it leads to an increase in the yield of the area of the semi-finished product, increasing its strength, softness and flexibility. The deposition of fatty materials on the layers of the semi-finished product continues in subsequent finishing processes, especially in drying and pressing. The efficiency of the fatliquoring process depends on the lubricants, their quantity, and process technology. Fatty materials of different nature have different effects on the properties of leather and fur, such as hardness, density, plasticity, durability, and abrasion resistance. Therefore, fatliquoring compositions are commonly used to impart desired properties to leather and fur. Product quality problems are inextricably linked to technology problems. Application of natural oils and lubricants to chrome-plated leathers, as well as their emulsions, ensures high elasticity and performance properties of the leather. However, the scarcity, high cost and, at the same time, the low quality of natural oils require solving the problem of replacing them with synthetic fatty materials that are not inferior in their technological properties. In order to expand the range of synthetic fatliquoring materials and emulsifiers based on them and replace rare and valuable natural oils in leather production processes, an improved fatliquoring composition with high fatty properties in combination with other materials based on industrial paraffin will be created in the following works. The emulsion fatliquoring method for processing chrome leather is one of the main methods known in the industry. The emulsion fatliquoring process ensures the homogeneity of fatty substances in the semi-finished product, softness, extensibility in the skin, it is worth noting that to achieve these results it is necessary to include the optimal amount of fatty substances in the skin. Unfortunately, leather production technology does not meet modern requirements. For example, in many cases, producing 1 kg of leather requires up to 1 kg of various chemicals. Also, when an aqueous solution of chemistry is introduced into the skin, about 60 liters of wastewater are formed per 1 kg of treated skin. The approximation of these effluents mainly depends on the chemical materials used in the process, especially on the chemical composition and technological parameters of the lubricant composition.

III. RESULTS

The study studied fatty emulsions containing different amounts of acids[1].

Table - 1

Composition of fat compositions

Fatty substances	**Mass fraction in the fatliquoring composition for various options**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Oxidized petroleum oil	10	20	30	40	50	60	70	-
Synthetic fat	60	50	40	30	20	10	0	50
Sulfated blubber	30	30	30	30	30	30	30	30
Spindle oils	-	-	-	-	-	-	-	20
Surfactants	1,5	1,5	1,5	1,5	1,5	1,5	1,5	3,0

The easiest way to control the level of fat absorption, their even distribution over the dermis layers and the strength of the bond is to choose fat mixtures and change their composition. The level of binding of collagen with fatty substances is influenced by the colloidal properties of the applied emulsions (aggregate stability, viscosity, surface tension), which are determined by the physicochemical characteristics of the fatty substances. With an increase in the amount of oil emulsion in the fatty composition from 10 to 70%, the stability of the aggregate increases, the surface tension decreases, and the viscosity increases [2]. Histological examination using laser electron microscopy showed a change in the degree of skin disaggregation in the area of the incision and the angle of inclination of collagen nodes, as well as the depth of absorption of the fatty mixture into the structure of the dermis and the nature of the distribution of substances in the layers of the skin.

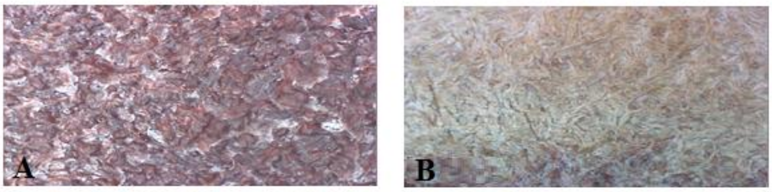

Fig 1. Appearance of the skin with a fattened composition based on oxidized oil products using a laser microscope. A) top view, B) inside view

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 11 , November 2020

The morphometric assessment of the experimental and control samples of the structural elements of the dermis is shown in table 2.

Table – 2
Morphometric assessment of the structure of the dermis

Processing option	Collagen node deflection angle	Collagen nodes thickness, microns	Distance between collagen nodes, microns
2.	48,0	48,1	7,4
5.	43,4	36,0	8,2
6.	41,3	30,7	8,7
7.	38,9	28,3	6,9
8.(K)	50,9	50,4	6,9

With an increase in the content of oxidized petroleum oil in the fatty mixture from 20 to 70%, a tendency towards a decrease in the angles of deviation of collagen nodes was observed. The use of oxidized gasoline in the oil mixture leads to an increase in the lubricating activity of the experimental emulsions, rather than the control ones. As a result of studying the distribution of fat along the internal structure and layers of the skin using light and electron microscopy, it was found that the breakdown of collagen into smaller structural elements depends on the composition of the fatty compound. From the point of view of the quantitative and qualitative characteristics of the morphological structure, the distribution of fatty materials in the structure of the dermis, the most effective fatty material turned out to be a mixture containing 50% oxidized petroleum oil. According to the results of the study of the distribution of fat over the layers of the structure of the dermis, the largest amount of fatty substances in the experimental and control variants is present in the superficial and bakhtarmian layers of the skin. As the amount of oxidized petroleum oil in the fatty mixture increases, the total amount of fatty substances in the skin increases [3]. Studies have shown that the distribution of fatty substances in the structure of the dermis largely depends on their colloidal-chemical properties, the ratio of various fatty substances in the total fat-fat composition. It was found that the porosity of the experimental skins increased with decreasing visual density index. The graphical representation of the experiment is shown in Figure 1, which shows the dependence of the total porosity of leather on the amount of oxidized petroleum oil in the fatty mixture.

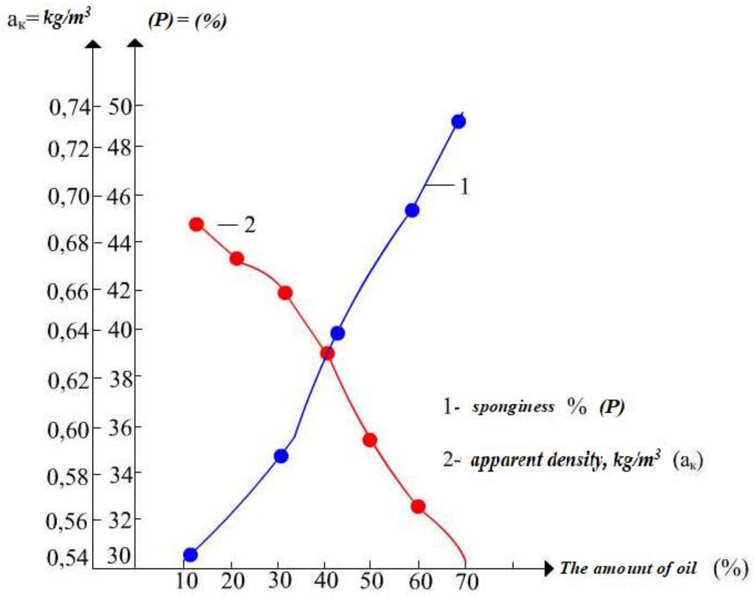

Figure 1. Dependence of the total porosity of the experimental leathers on the amount of oxidized petroleum oil in the fatliquoring composition.

When carrying out research work in order to determine the hygienic properties of the skin, samples of oily skin were subjected to physical tests and its porosity was determined. The apparent density is characterized by the ratio of its weight to the total volume of leather or fur and depends on the porosity of the leather structure and the degree of filling with fillers and fatty materials.

IV.DISCUSSION.

True density is the ratio of skin mass to skin density (no pores). Determination of the apparent density of the texture of leather and fur is based on the determination of the weight of the samples and their size [4]. Mass is determined by measuring a sample, and volume is the volume of liquid (eg mercury) that has been removed by the sample and not absorbed by the skin and its tissues. But for some leather types, such as suede and fur texture, the results are not as straightforward as they should be. In this case, mercury has a high specific gravity (13.6 g / sm^3) and the sample is

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 11 , November 2020

compressed. The apparent volume of these skins is determined by the liquid filling the pores: paraffin, xylene, toluene or carbon tetrachloride.

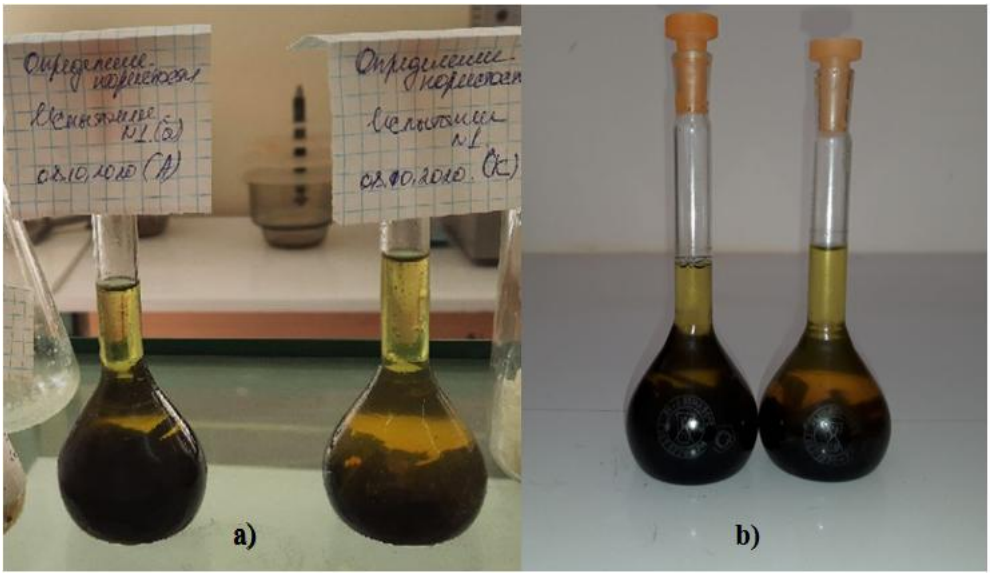

Figure: 2. Test for porosity of a sample of fatty leather
a) initial appearance of the test specimen; b) appearance after 24 hours.

A leather sample was cut into pieces 20 mm in size and 2 ... 3 mm in width. With a relative error of up to 0,01 g, 7 g of crushed particles were weighed, placed in a 50 sm^3 pycnometer and poured with kerosene to the special mark of the pycnometer. The volume of kerosene was determined V_1, sm^3, the pycnometer was closed with a stopper. The duration of the absorption of kerosene by the pores of the leather tissue was a day, during which time the pores were filled with kerosene (Fig. 2), and its volume in the pycnometer decreased. The pycnometer is refilled with kerosene up to the V_2 level. The difference between the volume of the pycnometer V_0 and the volume of filled kerosene is equal to the true volume of the sample, sm^3

$$V_u = V_0 - (V_1 + V_2) = 50 - (46 + 0{,}6) = 3{,}40 sm^3$$

3,40 sm^3 - sample volume.

After emptying the kerosene from the pycnometer, the pieces of skin were removed using copper wire and laid out on filter paper. Without squeezing the skin samples, the excess liquid was carefully soaked in filter paper. Then the samples for analysis were placed in a pre-dried pycnometer and again filled with kerosene. The difference between the volume of the pycnometer V_0 and the volume of paraffin filled in the second time V_3 is equal to the volume of dense skin substance, i.e. apparent volume, sm^3:

$$V_k = V_0 - V_3 = 50 - 44{,}3 = 5{,}7 sm^3$$

5,7 sm^3 - apparent volume of the sample.

From the difference between the apparent volume of the sample and the volume, we find the pore volume of the analyzed samples, sm^3:

$$V_n = V_k - V_u = 5{,}7 - 3{,}4 = 2{,}3\ sm^3$$

2,3 sm^3 - pore volume

Its porosity: $\Pi = 100 \cdot \frac{V_n}{V_k} = 100 \cdot \frac{2{,}3}{5{,}7} = 40{,}3\%$

40,3% - sample porosity

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 11 , November 2020

Table - 3
Porosity test results for leathers coated with a composition based on oxidized oil.

Experience number	Sample mass, gr.	Kerosene volume, sm^3			Sample volume, sm^3		Pore volume, sm^3
		V_1	V_2	V_3	$V_т$	$V_н$	
1	7	46	0,60	44,3	5,7	3,40	40,35
2	7	47	0,53	45,1	4,9	2,47	49,59
3	7	46	0,63	43,8	6,2	3,37	45,6
4	7	47	0,55	46,1	3,9	2,45	37,17
5	7	46	0,62	45,2	4,8	3,38	29,5

V.CONCLUSION.

From the experiments carried out, it can be concluded that when high fatty acids obtained from secondary petroleum products were included in the lubricant composition, we achieved a positive result in studying the physical and mechanical properties of leather, especially porosity. In the course of the study, the influence of oxidized petroleum oil was established on the chemical-analytical and physical-mechanical characteristics of leather for the upper of shoes. The results of testing the mechanical properties of leather are shown in table 4.

Table - 4
Mechanical testing of leather that uses oxidized petroleum oil for lubrication.

№	Indicators of mechanical properties	Fat options							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8(К)**
1	Average thickness, 10 $м^3$	1,56	1,52	1,58	1,58	1,54	1,55	1,58	1,58
	±	0,06	0,07	0,07	0,08	0,07	0,07	0,09	0,09
2	Tensile strength, 10 МПа	1,84	1,91	2,06	2,16	2,21	2,21	1,76	2,01
	±	0,08	0,09	0,08	0,11	0,13	0,14	0,12	0,14
3	Cracking stress, 10 МПа	1,59	1,64	1,68	1,76	1,78	1,72	1,53	1,81
	±	0,07	0,08	0,09	0,08	0,09	0,10	0,08	0,10
4	Elongation under stress, 10 MPa, %	32,1	32,8	34,3	36,1	39,1	41,1	42,2	30,7
	±	1,9	1,9	1,9	2,2	2,1	2,1	2,7	1,9
5	Tensile tear, %	53,6	58,5	58,5	61,7	64,5	62,3	57,4	58,1
	±	2,5	2,8	3,2	3,2	3,7	3,3	3,1	2,9
6	Breaking force, Н	25,5	25,8	26,3	28,7	30,9	29,5	26,8	25,4
	±	1,3	1,3	1,5	1,5	1,8	1,6	1,8	1,6
7	Stiffness according to PZhU (device for determining elasticity and stiffness), 10^{-2}H	22,9	21,5	20,6	20,2	17,6	16,0	14,6	21,9
	±	1,2	1,2	1,4	1,1	1,3	1,0	1,0	1,4
8	Elasticity according to PZhU, %	68,3	68,8	69,2	69,6	69,6	69,0	67,0	70,2
	±	3,6	3,2	3,8	3,8	3,3	3,6	3,3	3,9

A decrease in the indicators of mechanical tests in options 6 and 7, an uneven distribution of fatty materials in the structure of the dermis, may be associated with a decrease in the angle of deflection of the elements of the dermis. Comparing the hygienic properties of the leathers presented in Table 5, it was found that the use of oxidized oil in the lubricant mixture affects the following hygiene properties: wet return, hygroscopicity and dynamic water permeability increase, dynamic water permeability decreases slightly. Such a difference in characteristics depends on the ratio of various materials in the composition of the fatty mixture and the structural characteristics of the skin, their hydrophilic-hydrophobic properties. The high content of synthetic oil and oxidized petroleum oil in the mixture also affects the internal structure of the dermis in different ways and, therefore, the physical and mechanical properties of the skin. As the amount of oxidized petroleum oil in the fatty mixture increases, the porosity of the structure is achieved: the thickness of collagen nodules decreases, their number increases, and the interstructural distances lengthen.

Table - 5

Hygienic properties of chrome leather treated with oxidized petroleum oil.

№	Indicators of hygiene properties	Fatting options							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8(K)**
1.	Air permeability, 10^{-6} m^3/m^2c	3088	3310	3640	3953	4166	4210	4238	3244
	±	223	295	270	325	317	367	332	370
2.	Vapor permeability, %	36,1	37,6	38,4	40,7	42,4	44,8	48,6	36,8
	±	1,9	1,9	1,7	1,8	2,4	2,66	2,8	2,3
3.	Steam capacity, %	17,1	17,1	16,7	16,6	16,6	16,1	16,1	16,1
		1,3	1,3	1,3	1,3	1,1	1,2	1,2	1,1
4.	Hygroscopicity, %	14,1	14,3	14,3	14,6	14,7	14,7	14,9	14,1
	±	0,8	0,8	0,9	0,9	0,9	0,8	0,9	1,1
5.	Wetness, %	78,9	84,2	84,9	91,9	94,7	94,5	95,0	87,5
	±	4,0	4,7	4,7	5,3	5,1	5,5	5,2	4,9
6.	Dynamic water permeability, 10^{-3}kg	60,4	58,2	53,9	52,2	51,1	51,0	51,9	50,0
	±	4,4	4,2	3,6	3,7	3,3	3,5	3,4	4,2
7.	Dynamic wetness, min	4,1	4,1	3,8	3,6	3,2	3,1	3,1	3,7
	±	0,2	0,2	0,2	0,2	0,2	0,1	0,2	0,2
8.	Moisture rejection, %	4,9	5,1	5,4	5,6	5,8	6,0	6,0	6,1
	±	0,3	0,2	0,2	0,3	0,3	0,3	0,3	0,2

VI. ACKNOWLEDGEMENT.

Studies of the use of leather based on oxidized petroleum products have shown that the use of this product in the composition of a fatliquoring material can lead to obtaining leather that is more resistant to adverse factors than the control skin greased with 20% spindle oil. Leather, greased with a composition with an optimal content of 50% oxidized petroleum oil, has the best consumable properties. In this scientific study, a comprehensive study was carried out of the effect of the amount of oxidized petroleum oil used in the fatliquoring composition on the consumer properties of fatty leathers. As a result of these studies, the maximum possible amount of oxidized petroleum oil in the fatliquoring composition was determined.

REFERENCES

[1]. Fadeeva T.P. Consumer properties of chrome leathers for shoe uppers made with the use of oxidized petroleum oil. Abstract dissertation on sois. uch. Art. Cand. tech. sciences. Moscow 1990, p. 26.

[2]. Khujakulov K.R., Mavlanov B.A., Narzullaeva A.M., Fozilov S.F. Obtaining fatty ingredients for leather processing based on local raw materials. Tashkent: Publishing house "VNESHINVESTPROM", 2019. - 150 pp.

[3]. Khujakulov K.R., Sadullaeva D., Nodirov A.A. Application of refined products of petroleum synthetic fatty materials for fattening leather. TOPICAL ISSUES OF THE DEVELOPMENT OF MODERN SCIENCE Abstracts of VI International Scientific and Practical Conference Sofia, Bulgaria 12-14 February 2020.p.936-943.

[4]. Khujakulov K.R, Niyozova R.N, Fozilov S.F. Modification of synthetic fat and its application for fattening leather. DYNAMICS OF THE DEVELOPMENT OF WORLD SCIENCE Abstracts of V International Scientific and Practical Conference Vancouver, Canada 22-24 January 2020., pp. 767-771.