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Resistance characteristics of secondary leather tissue finished with elastic polymer adhesives to the effect of gasoline

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ABSTRACT. The resistance properties of the secondary leather fabric coated with elastic polymer adhesives to gasoline were doubled compared to the control, taking into account the effect of its surface properties.

KEYWORDS:. Elastic, polymer, adhesive, finishing, collagen, secondary leather tissue, structure, crude rubber, plasticizer, soot, aerosil, pigment, "Galosha" gasoline, break at relative elongation, residual elongation, cold resistance and hardness.

I. INTRODUCTION

The structural miracle of collagen creates natural leather. Leather matrix is superior to other synthetic matrices [1-3]. The production of leathers with high decorative properties, elastic, pleasant to the touch, and high physical and mechanical properties is one of the main tasks of the leather and fur industry. Technological discipline, quality control at all stages of the technological process, use of modern equipment, advanced methods of leather tissue processing, and introduction of new effective chemical materials can solve it.

As a means of protecting products from the effects of aggressive agents, elastic polymer adhesives are widely used in the production of general and special materials, including the leather and fur industry. One of the main requirements for such materials is the resistance of the elastic polymer adhesive to the effects of petroleum products, particularly gasoline. The protective properties of elastic polymer adhesive are mainly determined by the chemical nature of the film-forming agent [4].

II. METHODOLOGY AND DISCUSSION

Rubber, (Latin: rubber - resin (resin)), vulcanizate - a product made from vulcanizing rubber, with very high elastic deformation (up to 1000%) [5]. The main components of the vulcanizable rubber mixture: natural or synthetic rubber, vulcanizing agents, vulcanization accelerators, vulcanization accelerator activators, fillers, dispersants, softeners, non-toxic substances, antiozonates, dyes, etc.

Adhesion indicator W_a was calculated from the data of surface tension Y and equilibrium wetting angle [6]. Edge contact angles were determined using a microscope on a 5% collagen gel in a glass slide. As the equilibrium value of the wetting angle, the value after 3 seconds after the drop was introduced on the surface of the gel was taken. Measuring accuracy ±2 °C. The mechanical properties of leather and fur [6] were determined by the traditional method.

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III. EXPERIMENTAL RESULTS

Based on the above, we were given the task of creating a new method of finishing the surface of the secondary leather tissue based on elastic polymer adhesive, which allows us to improve the adhesion properties during long-term use of the product.

The task of improving the adhesion properties during long-term use of articles was solved in the study of obtaining and properties of elastic polymer-adhesives. The researched elastic polymer - adhesives have raw rubber (unvulcanized rubber), vulcanizer - Kaptaks MBT, accelerator - Altaks DTDM, stabilizer - Stearin, plasticizer - DOF, filler (soot, aerosil, pigment) and solvent - "Galosha" gasoline.

Table 1 presents various options for obtaining elastic polymer adhesives.

Table 1.
Compositions of elastic polymer-adhesives in control [7] and experimental variants

№	Coating paint composition	Coating paint composition, mass fraction				
		Control	Experimental			
		I	II	III	IV	V
3	Baigen top U	85	-	-	-	-
4	Baigen top A	8	-	-	-	-
5	Raw rubber (fully unvulcanized rubber)	-	80	90	100	110
6	Vulcanizer - Captax MBT	-	4	4	4	4
7	Accelerator Altax DTDM	-	3	3	3	3
9	Baygen C (hardener)	54	-	-	-	-
10	Stabilizer - Stearin	-	1	1	1	1
12	Plasticizer - DOF	-	5	5	5	5
14	Filler (soot, aerosil, pigment)	-	12	10	8	6
15	Organic solvent mixture	34	-	-	-	-
17	Solvent - "Galosha" gasoline	-	76	68	60	52
Total:		181	181	181	181	181

An elastic polymer adhesive based on fully unvulcanized rubber provides useful properties unattainable in conventional rubbers. First, this elastic polymer adhesive has an increase in hardness, which allows it to be used for products with especially strong mechanical loads, for example, for cold rolling shafts or steel bending, and secondly, it has an incomparable wear and scratch resistance.

The purpose of this study is to determine the effect of the chemical nature of the film-forming substances on the gasoline resistance of the multilayer elastic polymer adhesive of the secondary leather tissue and the role of the physical and chemical properties of the surface of the secondary leather tissue as a substrate in the formation of the gasoline-resistant elastic polymer adhesive.

Elastic polymer adhesives based on raw rubber (not fully vulcanized rubber) in the experimental options listed in Table 1 above were selected as the research object. It was compared with the coating according to the existing technology based on experimental elastic polymer adhesives. Experimental and control elastic polymer adhesives were prepared according to current technology, and control samples with common physicochemical properties of secondary leather tissue were used.

To clarify the effect of the physicochemical properties of the surface of the secondary leather tissue on the gasoline resistance as a substrate for an elastic polymer adhesive, the secondary leather tissue of a large horned ox divided into two parts with chromium was used for the experimental and control options listed in Table 1 above.

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The physicochemical properties of the surface of the secondary leather tissue surface of the bifurcated large horned ox with chromium were evaluated by the following indicators: wettability (hydrophilicity, water absorption), sign and magnitude of the electrokinetic potential, and the content of unbound fat [8].
An elastic polymer adhesive based on crude rubber (not fully vulcanized rubber) was applied to the surface of the secondary leather tissue of the bifurcated large horned ox of the above options. A-92 gasoline was used as an aggressive medium. The gasoline resistance of the elastic polymer adhesive in the secondary leather tissue was evaluated by the amount of swelling of the samples in the aggressive environment and the change in the adhesion of the elastic polymer adhesive to the secondary leather tissue under the influence of the aggressive environment compared to the control option. Elastic polymer adhesives and secondary leather tissue samples treated with them were tested. The method of studying the degree of fading of secondary leather tissue samples finished with elastic polymer adhesives provides a one-way effect of the environment on the elastic polymer adhesive.

Adhesion of elastic polymer adhesive to secondary leather tissue was determined by a known method [9], in which the tissue was glued with elastic polymer adhesive glue and soaked in gasoline for 60 minutes, then kept under load for 60 minutes. Samples for research were taken according to GOST 9209-77. The results of the study of the effect of gasoline on the multilayer coating of the secondary leather tissue treated with elastic polymer adhesives are presented in Table 3. The obtained data show that gasoline causes a change in the elastic polymer adhesive properties. The experimental elastic polymer adhesive has higher gasoline resistance than the control samples. The experimental increase in the resistance of the elastic polymer adhesive to the effect of gasoline is probably due to the less penetration of the aggressive environment into the elastic polymer adhesive, which can be explained based on the mechanism of the effect of the aggressive environment on the elastic polymer adhesive.

The mechanism of the effect of an aggressive medium on an elastic polymer adhesive is related to its diffusion into the elastic polymer adhesive, its cracking and weakening of the interaction between the elastic polymer adhesive and the substrate, and the aggressive medium accumulates at the > 1-phase interface [10-11]. These factors can appear simultaneously in various combinations.

Table 2
The effect of gasoline on the multilayer coating of secondary leather tissue treated with elastic polymer adhesives

Samples		The rate of absorption of samples into gasoline for 2 hours, %	Adhesion, N/m		Coefficient of resistance to gasoline
			dry	In gasoline	
Control	I	32	1575	345	0,22
Experiment	II	28	1870	450	0,24
	III	23	2010	510	0,25
	IV	18	2350	640	0,27
	V	21	2130	560	0,26

Analyzing the data in Table 2, it can be noted that experimental variants made of elastic polymer adhesive based on raw rubber (not fully vulcanized rubber) achieved significantly less bending than the control variants. Reducing the amount of swelling from the bottom of the elastic polymer adhesive slows down the further spread of gasoline, reduces the amount of swelling of the elastic polymer adhesive in general, and thus reduces its accumulation at the interface of the elastic polymer adhesive - secondary leather tissue, the effect of an aggressive environment on the adhesive effect.
Experience also helps with better adaptation of elastic polymer adhesive layers, as it is formed based on a single monolithic curtain-forming agent and better adheres to secondary leather tissues. An increase in the adhesion of the elastic polymer adhesive to the substrate can increase the resistance of the coating to the effects of an aggressive environment [12].

The results of determining the physicochemical properties of the surface of the secondary leather tissue surface of the bifurcated large horned ox as a substrate for elastic polymer adhesive and their role in the formation of gasoline-resistant elastic polymer adhesive are presented in Table 3.

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Table 3
Physico-chemical properties of the surface of secondary leather tissue finished with elastic polymer adhesives

Samples		Hydrophilicity	Water absorption volume, ml	Fat content, %	Adhesion		Coefficient of resistance to gasoline
					dry	In gasoline	
Control	I	1,64	0,72	3,9	1575	345	0,22
Experimen	II	1,43	0,53	3,5	1870	450	0,24
	III	1,58	0,48	3,8	2010	510	0,25
	IV	1,31	0,33	3,6	2350	640	0,27
	V	1,41	0,41	3,8	2130	560	0,26

Physico-chemical properties of the secondary leather tissue change during degreasing and dyeing, and the nature of the dye affects the nature of these changes. According to the obtained data, the experimental increase in the resistance of the elastic polymer adhesive to the effect of gasoline is due to the increase in the adhesion of the elastic polymer adhesive to the secondary leather tissues, which is related to the change in the physicochemical properties of its surface [13-14].

Degreasing the secondary skin tissue increases its surface wettability while removing unbound fat from the structural elements of the secondary leather tissue in its surface layer brings the interacting surfaces (elastic polymer adhesive and secondary leather tissue) closer together and increases the contact area between them, and thus the elastic polymer increases secondary leather tissue adhesion with adhesive. We determined the specific surface area of secondary leather tissue (natural semi-finished product) before and after degreasing: 1.75 and 2.89 m^2/g, respectively.

The importance of these factors is confirmed by one of the rules of the theory of adhesion, namely: elastic polymer adhesive — the factor that ensures the occurrence of intermolecular interaction at the boundary of secondary leather tissues is the adsorption (molecular) nature of the adhesion of elastic polymer adhesive.
Strong and electrovalent bonds play a certain role in the adhesion of the elastic polymer adhesive based on raw rubber to the secondary leather tissue, which in turn is confirmed by the presence of groups capable of forming bonds. Their range of motion is in the range of 0.5-10 nm [13]. Thus, for the highest interaction between the elastic polymer adhesive and the secondary leather tissue, the distance between them should be less than 10 nm. This means that if a thin layer of fat appears on the surface of the secondary leather tissue, this condition will not be met and the adhesion of the coating will be reduced.

During the dyeing process, changes in the physical and chemical properties of the surface of the secondary leather tissue are related to the nature of the dye, its structure, and the mechanism of interaction with collagen. The decrease in the electrokinetic potential of the surface of secondary leather tissues painted with anionic dyes is due to their interaction with collagen functional groups and the sitting of oppositely charged dye molecules on the surface of secondary leather tissues.

Metal-complex dyes dramatically reduce the charge of the surface, because they penetrate shallowly into the secondary leather tissues, and their effect is noticeable in the surface layer. The metal-complex paint is characterized by high diffusion ability, penetrates deep into the secondary leather tissues, and is less affected by the charge of the surface layer. This is also due to the high hydrophilicity of the surface of the secondary leather tissue painted with metal-complex dyes.

Thus, in these processing options (Table 2, options 3 and 4), changing the properties of the surface of the secondary leather tissue in the direction of increasing the contact area and completeness between the elastic polymer adhesive and the secondary leather tissue (option 4) improves the adhesion of the elastic polymer adhesive and its gasoline increases resistance to its effects.

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Adhesion of the elastic polymer adhesive and its resistance to its effects can be related to the interaction of the paint (metal-complex) and the film-forming agent, along with these factors. The possibility of this interaction is determined by the presence of polar carboxyl groups in the film-forming agent, which can enter the inner sphere of the complexing agent.

IV. CONCLUSION AND FUTURE WORK

Based on the experience, it can be concluded that the chemical nature of the film-forming agent used not only in the upper layer of the elastic polymer adhesive, but also in the lower part affects the resistance to gasoline of the secondary leather tissue multilayer elastic polymer adhesive; as a substrate for an elastic polymer adhesive, the surface area of the secondary leather tissue affects its resistance to the effects of gasoline; the effect of physical and chemical properties on the surface of the secondary leather tissue is determined by the degree of adhesion effect on the resistance of the elastic polymer adhesive to the effect of gasoline; the adhesion of elastic polymer adhesive to the secondary leather tissue and its resistance to gasoline are significantly affected by the composition and distribution range of unbound fat in it, as well as the wetting ability of the secondary leather tissue; An experiment on secondary leather tissue showed that the resistance to gasoline of an elastic polymer adhesive based on raw rubber doubled compared to the control, taking into account the effect of the surface properties of the secondary leather tissue.

REFERENCES

[1] Osman, S.O., Selway, J.L., Parvathy, E.H., Stocker, C.J., Wargent, E.T., Cawthorne, M.A., Jassim, S., Langlands, K.; A novel method to assess collagen architecture in skin. BMC Bioinformatics. doi: 10.1186/1471-2105-14-260, 2013.

[2] Bhattacharjee, A., Bansal, M.; Collagen structure: the Madras triple helix and the current scenario. IUBMB Life 57, 161-172, 2005.

[3] Ramachandran, G.N.; The 1967 John Arthur Wilson memorial lecture: molecular architecture of collagen. JALCA 63, 161-170, 1968.

[4] Matrenin S.A. Composite materials and coatings on a polymer basis: a tutorial / S. V. Matrenin, B. B. Ovechkin; -Tomsk: TPU Publishing House, 2008. - 190 p.

[5] Rubbers with special properties: a tutorial / V.F.Kablov, O.M.Novopoltseva, M.P.Spiridonova, D.A.Kryukova; VolGTU. - Volzhsky, 2020. - 185 p. Zhansakova K.S. Porous heat-insulating rubbers based on butadiene-methylstyrene rubber: Diss... Cand. of Technical Sciences. - O.: Omsk - 2022. - 128 p.

[6] Danilkovich A. G. Analytical control in the production of leather and fur: laboratory practical training: Textbook / Danilkovich A. G., Chursin V. I. - M: NITs INFRA-M, 2016. - 176 p.

[7] Babloyan V. P., Balberova N. A., Eremina I. A., Shulenkova E. I., Ivanova R. A., Peskin Ya. I. "Tanner's Handbook. (Finishing. Production Control)" \\ Edited by Balberova N. A. - Moscow: Legprombytizdat, 1987 - p. 256

[8] V.I.Chursin. Chemistry and technology of leather and fur. Laboratory practical training: textbook / V. I. Chursin. - Moscow: RSU named after A. N. Kosygin, 2013. - 72 p.

[9] V.I. Chursin. Technologies and materials for leather finishing. Laboratory practical training: textbook / V.I. Chursin. - Moscow: RSU named after A.N. Kosygin, 2020. - 83 p.

[10] Matrenin S.A. Composite materials and coatings on a polymer basis: textbook / S.V. Matrenin, B.B. Ovechkin; -Tomsk: TPU Publishing House, 2008. - 190 p.

[11] L.N. Maskayeva, E.A. Fedorova, V.F. Markov. Technology of thin films and coatings: textbook /; [under the general editorship of L.N. Maskayeva]; Ministry of Science and Higher Education of the Russian Federation, Ural. Federal University. - Ekaterinburg: Ural Publishing House. University, 2019. – 236 p.

[12] L.N.Maskaeva, E.A.Fedorova, V.F.Markov. Technology of thin films and coatings: textbook /; [under the general editorship of L.N. Maskaeva]; Ministry of Science and Higher Education of the Rus. Federation, Ural. Federal University – Ekaterinburg: Publishing House of Ural. University, 2019. – 236 p.

[13] Strakhov I.P., Golovteeva A.A., Kutsidi D.A., Sankin L.B. Leather finishing. M., Light industry, 1976. 375 p.

[14] L.N.Maskayeva, E.A.Fedorova, V.F.Markov. Technology of thin films and coatings: studies. the manual /; [under the general editorship of L. N. Maskayeva]; M-in science and higher education. education of the Russian Federation, Ural Federal District. university. – Yekaterinburg: Uralsky University Publishing House, 2019. – 236 p.