SORPTION PROPERTIES OF SECONDARY SKIN TISSUE SIMULATED WITH ELASTIC POLYMER ADHESIVES

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Эластик полимер адгезивлар билан имитацияли бойитилган иккиламчи тери тўқимасининг сорбцион хоссалари ўрганилган. Имитациялаенган иккиламчи тери тўқимаси ички солиштирма юзасининг кенгайиши, ғовакларнинг миқдори ортганлиги билан изоҳланади.

Изучены сорбционные свойства вторичной спилка, имитационно обогащённой эластополимерными адгезивами. Расширение удельной внутренной поверхности имитированной вторичной спилка обусловлена увеличением количества их пор.

The sorption properties of secondary split leather, imitation-enriched with elastopolymer adhesives, have been studied. The expansion of the specific internal surface of the imitated secondary split leather is due to an increase in the number of its pores.

During the operation of leather materials, favorable conditions are largely determined by the sorption-hygienic properties of the leather, which, in turn, depend on the development of its internal surface, the volume, number, and configuration of the pores, as well as the degree of blocking of the active groups in the leather collagen that can interact with vapors. Studies dedicated to the investigation of the sorption properties of collagen and gelatin [1 2] have been carried out by many authors for various purposes.

While acknowledging the usefulness of the data obtained from these studies, which helped to expand the understanding of structural changes in the collagen composition forming the basis of leather and fur tissues, it should be noted that the equipment and methods used do not allow for the detection of a number of subtle changes in collagen. Most of the research was conducted using the desiccator method. Studies on the formation and determination of the pore structure of leather materials during their operation have shown that the structure is mainly formed during the finishing process.

In this study, what is important for us is the physical indicators of leather structure related to porosity during the finishing processes, and our goal is to expand our understanding of them. Using modern methods for studying porosity, we investigate the porosity of leather enriched through simulation with an elastic polymer adhesive based on rubber, employing the adsorption method.

In this study, while obtaining elastic polymer adhesives and investigating their properties, the task of improving adhesion characteristics during the long-term use of products was addressed. The elastic polymer adhesives studied by four methods contained raw rubber (partially vulcanized rubber), a vulcanizing agent (Captax MBT), an accelerator (Altax DTDM), a stabilizer (stearin), a plasticizer (DOF), fillers (carbon black, aerosil, pigment), and a solvent ("Galosha" gasoline).

To study the adsorption process in leathers, a McBain-Bakr spring balance apparatus was used. The sorption of water vapor was monitored through independent weighing, which significantly increased the accuracy of the experiment.

Despite the differences in the composition and structure of the finishing of leather tissue samples treated with elastic polymer adhesives, all the sorption isotherms have an S-shape. At the same time, the adsorption of water vapor is distinguished by its curved nature at low pressure values. According to the Brunauer classification, all the samples' isotherms correspond to type 2 isotherms [3].

An analysis of the literature related to the research revealed that at the beginning of the isotherm殿 curve, if the bulge is directed toward the ordinate axis, this indicates that the interaction energy between the molecules of the adsorbate is smaller than the interaction energy between the adsorbate and adsorbent molecules. This suggests that the diffusion of the adsorbent (water vapor) into the structure of the leather treated with elastic polymer adhesives occurs rapidly. Such results can be observed in all the control and experimental samples.

In the sorption isotherms, three main stages can be observed: first, monomolecular, second, polymolecular adsorption regions, and third, capillary condensation regions. In all the isotherms, the first stage follows the Langmuir law, meaning that at low pressures, the intensive sorption process takes place. For this region, the curve殿 slope coefficient is high, while in the polymolecular adsorption region, the slope coefficient is much lower, and for most samples, the isotherm pressure values start from P/Pc = 0.12 0.25. For the second region, the isotherm pressure range is P/Pc = 0.37 0.75, and for the third region, it ranges from P/Pc = 0.87 1.00.

The specific surface area (C) of the adsorbents殿structure, based on porosity indices, was determined using the Brunauer, Emmett, and Teller (BET) theory equation. In this case, by plotting the ordinate as P/Pc / a(1-P/Pc) and the abscissa as P/Pc values, a straight-line coordinate system is obtained. The specific surface area of the adsorbents was calculated using the following formula [4]:

$$C=a\text{м}\cdot HA\cdot \omega 0$$

Here: S – specific surface area (m^2/g); am – monomolecular layer (mol/kg); N_A – Avogadro's number; ω_0 – surface area occupied by one molecule (nm^2).

The results obtained from the adsorption experiments and calculated using the BET formulas are presented in the table.

Table

Sorption Characteristics of the Pore Structure of Leathers

Parameters		Control and leather tissue samples treated with elastic polymer adhesives				
		Control	Experiment			
		1	2	3	4	5
Monolayer capacity A_m, mol/kg		1,969	1,577	2,374	2,569	2,328
Specific surface area S_{ud}, m²/g		128,00	102,50	154,38	167,05	151,36
Micro-pore W_0, sm³/g		0,111	0,087	0,133	0,145	0,127
Saturation volume V_S, sm³/g		0,165	0,136	0,209	0,240	0,202
Mesopore W_{me}, sm³/g		0,05	0,05	0,08	0,10	0,08
Pore radius $r_к$,	Å	28,7	27,2	26,5	25,7	26,7
	nm	2,87	2,72	2,65	2,57	2,67

Based on the increase in the amount of sorption, the samples can be arranged in the following order:

Variant 1 → Variant 2 → Variant 5 → Variant 3 → Variant 4

In the control method, the leather tissue structure has large pores with a radius of r_k = 2.87 nm. However, due to the small specific surface area S_{ud} = 128.00 m²/g, its sorption properties are low. The volume of micro-pores in the sample is W_0 = 0.111 sm³/g, and the volume of meso-pores is W_{me} = 0.05 cm³/g, both of which are small. When leather tissue is treated with elastic polymer adhesives, depending on the composition, the pore radii in the samples decrease from r_k = 2.72 nm to 2.57 nm, and their specific surface area S_{ud} increases from 102.50 m²/g to 167.05 m²/g. At the same time, the volume of meso-pores and micro-pores increases by 1-2 times. We can observe that the pore radii decrease by up to 12% (from 2.87 nm to 2.57 nm).

Thus, the conducted research demonstrated a wide range of variation in the specific surface area indicator. This confirms the complex nature of the process mechanism of forming a film with elastic polymer adhesives on the surface of leather tissue from multi-component compositions.

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