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Research of the Structure and Properties of Natural Composite Material - Natural Skin

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ABSTRACT: This article provides information on the study of the structure of leather for the upper of chrome-tanned shoes by scanning electron microscopy. Natural skin has a protein structure, the structural features of the skin are determined by the stacking of collagen fibrillar protein chains. Based on the conducted microscopic studies, the dependence of the structure of the leather and its porosity with the physicochemical properties of leather for the upper of chrome-tanned shoes was established.

KEYWORDS: Key words: composite material, best available technology, tanning agent regeneration, chrome tanning of leather, crust, scanning electron microscopy, secondary electrons, directional electron beam, capillary-porous structure, facial membrane, dermis structure, structure porosity.

I. INTRODUCTION

At the present stage of development of the economy of Uzbekistan, the most urgent problem is the development and implementation of a long-term strategy for sustainable development, industrial and processing industries, which include the leather industry. The leather industry is one of the branches of the light industry that processes the skins of various animals, mainly cattle, sheep, goats, horses, etc. The products of the leather industry are leather for the bottom and top of shoes, saddlery, clothing and haberdashery, technical leather, leather for upholstery and car interiors. The industry traditionally plays a significant role in the country's economy, providing a large number of industrial and processing industries with a standard assortment of leather and other products and products of processing protein waste, producing a wide range of consumer goods and industrial products. The importance of leather materials in the economy to challenge scientists to consistently improve the quality of leather. The properties of natural leather for the upper of shoes are, of course, first of all, the set of properties of the hide itself, which, during technological operations of leather dressing, changes and transforms as a set of properties of finished leather for the upper of shoes [1-2].

The formation of the properties of finished leather for the upper of shoes, their qualitative and quantitative values are largely determined by the nature of the chemical materials used in the production of leather. Currently, such chemical materials for the processing of leather raw materials include organic and mineral acids, bases, salts, enzyme preparations, various solvents, surfactants (surfactants), mineral and organic, high molecular weight tanning compounds, various low molecular weight and high molecular weight fillers, fats and dyes, various film-forming agents, pigments, varnishes, dispersions, plasticizers and much more. Separately, it should be noted that all of the listed chemical materials have different physical and chemical properties, such as solid, emulsion, liquid, dissolved, plasma, etc. As a result of chemical technology in leather production, all these materials are involved in the formation of a natural composite material - like leather. In the conducted studies, the tasks were set to study the structure of leather for the upper of shoes by the method of electron microscopy of cattle skins produced from raw materials harvested in Uzbekistan.

Electron microscopy is a technique for examining structures that are out of sight of a light microscope and are less than one micron in size. Electron microscopy is one of the main methods for studying biological micro-objects. Scanning and transmission electron microscopy makes it possible to study objects in a wide range of magnifications from the macrolevel of matrix organization to the thinnest cell membranes and the structure of cell nuclei, including obtaining volumetric images of the surface. Scanning electron microscopy detects secondary electrons emitted by the sample when the electron beam hits, and the electrons reflected by the sample. [3].

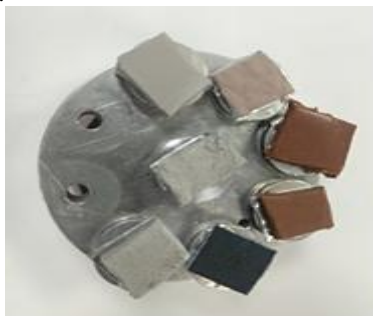
II. OBJECTS AND RESEARCH METHODS

To carry out electron microscopic studies of the macro- and microstructure, samples of crust and finished leather for the upper of shoes and a semi-finished product were taken. All the samples under study were obtained from raw cowshed medium (weight 18-20 kg). In the dyeing and fatty processes during the processing of leather, chemical materials and technology of the Turkish company "ODAK" were used [4]. Samples of crust and finished leather were unpolished, and on some samples nitrocellulose varnish was applied to the front surface of the leather. Samples of crust and finished leather for uppers were produced as semi-leather and had an average area of 130-140 dm², the length along the back line was 200-210 mm and the average thickness of the leather was 1.30-1.40 mm.

When determining the physicochemical properties, the mass of leather samples was determined on an analytical balance with an accuracy of 0.0002 g, the thickness of the leather was measured using a special thickness gauge to determine the thickness of the skin with an accuracy of 0.01 mm. When analyzing leather samples, the methods of analysis of the International Union of Leatherworkers and Chemists (IULTCS) [5] were applied. The following methods of analysis were used in scientific research: sampling and samples were taken using the IUC 2 "Sampling" method, and the IUC 3 method was used for preparing the test material.

Scanning electron microscopy is commonly used to examine the surface of a sample, although the scanning transmission electron microscopy option allows for the examination of thin sections. In this method, preparation of samples for microscopic examination is very difficult, since biological tissue samples, as a rule, very weakly interact with electrons. Ultrathin sections (up to 50 nm) are used, which are obtained after a multi-stage procedure for fixation, drying of tissues and embedding in solid media (resins). Biological objects have low contrast, therefore it is necessary to artificially enhance the contrast of the drug. There are several ways to increase the contrast of drugs. When shading the preparation at an angle with platinum, tungsten, carbon, it becomes possible to determine the dimensions on electron microscopic images along all three axes of the spatial coordinate system.

The operation of an electron microscope is based on the use of a directed stream of electrons, which performs the work of a light beam in a light microscope, and magnets (magnetic lenses) play the role of lenses. Due to the fact that different parts of the object under study trap electrons in different ways, a black and white image of the object under study is obtained on the screen of an electron microscope, magnified tens and hundreds of thousands of times. In studies of the structure of the skin tissue of leather samples, an SEM-EVO MA 10 electronic scanning microscope (Karl Zeiss, Germany) was used. Electron microscopy studies were carried out as follows: taking into account the dielectric nature of the samples under study, it was required to spray an electrically conductive layer on the sample surface to neutralize the electric charge generated on the sample by electron beams incident on the sample. Gold and silver elements were selected for deposition from the most suitable metals with a high yield of secondary electrons that transmit electrons and the deposition was carried out by magnetron deposition. Sputtering was carried out in an argon gas atmosphere. For dusting, a Quorum model Q150R ES magnetron atomizer was used. The thickness of the film formed on the sample surface was 10 nanometers, and the film deposition rate was 1-5 nm / min. In experimental studies on a scanning electron microscope, sampling and preparation of samples were carried out as follows: For the study, 2x1 leather samples (cm.) were prepared, they were installed on a round metal alloy stand (Fig. 1), on top of which was glued aluminum foil with a double-sided adhesive surface. During the measurement, an accelerating voltage of 20.00 kV (EHT - Extra High Tension) was used, the working distance (WD - working distance) was 10 mm. Images of various sizes up to 200, 20 and 10 μ m were acquired using SmartSEM software. The measurement was carried out in the secondary electronic detector (SE1) mode.



Rice. 1. Placing skin samples on the working board of an SEM-EVO MA 10 electron microscope (Karl Zeiss, Germany).



The samples formed a hemispherical plasma of silver ions, which covered the surface of the samples with a thin film. Experimental samples of leather materials were placed on a microscope stage. The sample surface is not coated with conductive carbon or other metal. Next, the stage was installed on the working chamber of the microscope, from which air was evacuated. The studies were carried out at an accelerator voltage of up to 10 kV in the SEI detection mode (secondary electronic detector). Working distance 8.5 mm. Images were taken at a scale of 20-100 microns [6].

The characteristics and designations of the studied samples of crust and leather for the upper of shoes and leather split are given in table No. 1

Table No. 1

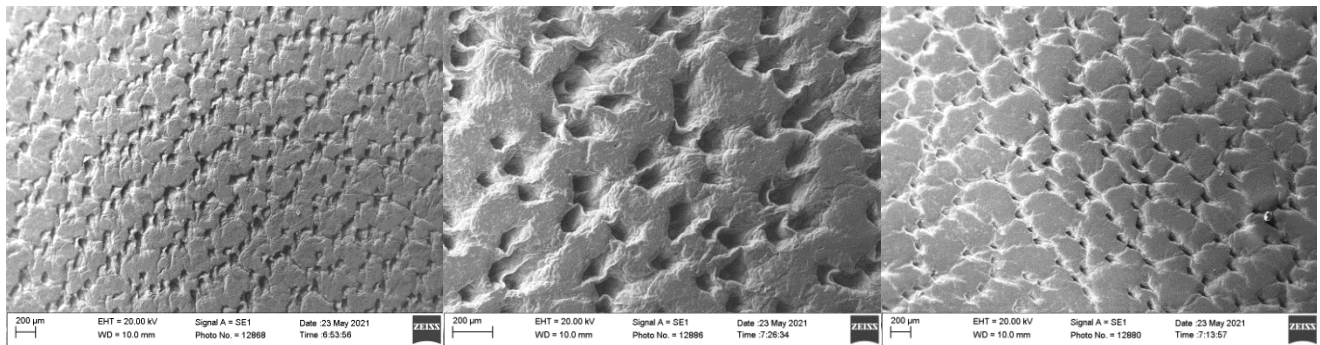
Characteristics and designations of the studied samples of crust and leather for shoe uppers and leather split

| Sample number | Sample type |
|---------------|--|
| 1-sample | Semi-finished product after the tanning and curing process |
| 2- sample | Semi-finished product after dyeing and fatty processes (Crust) |
| 3- sample | Semi-finished product with a refined front surface, at the stage of topcoat dyeing, after pressing |
| 4- sample | Finished leather with natural grain surface |
| 5- sample | Leather split after tanning |

To calculate the fractional number of voids from the total amount of the sample area in electron microscopic photographs, the AutoCAD Map 3D program was used [7].

III. RESULTS AND DISCUSSIONS

As a result of the conducted electron microscopic studies, the following photographs of skin samples were obtained (Fig. 2 and 3).

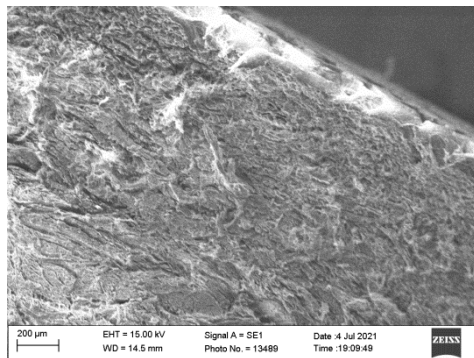


a) 1- sample

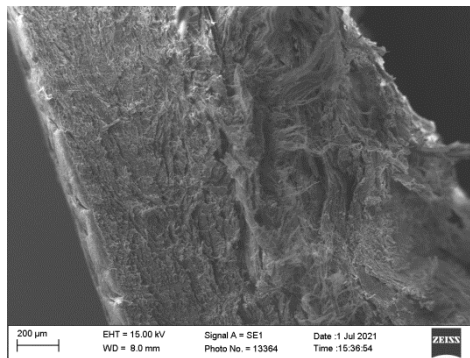
b) 2- sample

b) 3- sample

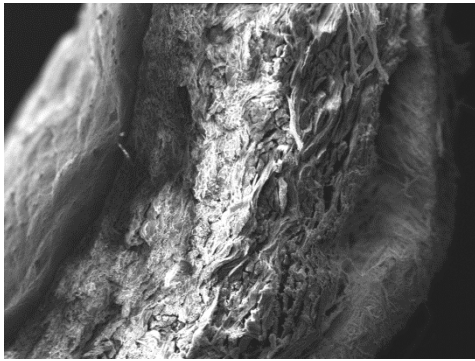
Rice. 2. SEM images of the front surface of leather samples.



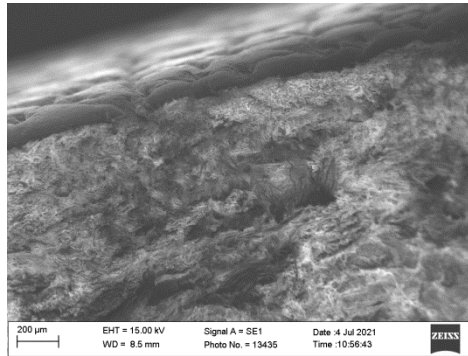
a) 1- sample



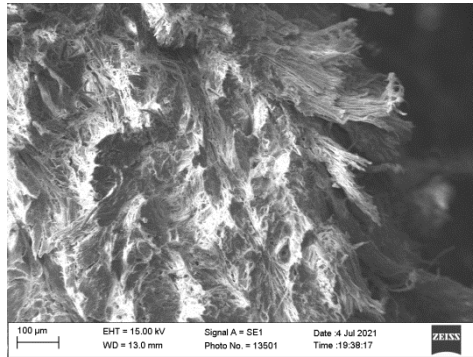
b) 2- sample



b) 3- sample



r) 4- sample



п) 5- sample

Rice. 3. SEM images of the images of the cross-sectional structure of the experimental samples.

The study of electron microscopic micrographs of the front surface of the prepared samples (Fig. 2) showed the presence of a dense relief surface on all samples of the split forage. Facial membrane consisting of densely packed fibers of proteins and voids that are formed after hair removal in general for all facial skin is similar. For the presented drawings of samples (Fig. 2), using the AutoCAD Map 3D program, we calculated the fractional number of voids from the total area of the sample in Fig. 2. The following results were obtained: 1-sample-23.76%, 2-sample -18.70% and 3-sample-9.52%. As can be seen from the data obtained, the greatest degree of openness of the front membrane is observed on the semi-finished product after tanning; in the process of subsequent operations of dyeing and fatty and finishing processes, this indicator gradually decreases. The following fig. 3 shows micrographs of cross-sectional samples with a magnification of 1000 times. The results of electron microscopic studies show that all samples show a capillary-porous structure and a fibrous structure of semi-finished products and skin. All samples have a certain, differing degree of fiber separation. It should be noted that the regularity of the structure and the compactness of the laying of the fibers is especially clearly visible on a sample of finished leather. It is also seen that on the sample with a coating film, the porosity is significantly reduced due to the presence of a continuous coating film. The split sample clearly shows the absence of a face membrane and the presence of large spaces with pores. Another feature observed in the microstructure of all samples is that it has a homogeneous structure. Various chemical substances (fillers, fats, dyes and other chemical materials used in dyeing and fatty processes) represent the formation of homogeneous phases with the structural elements of the skin and thereby form a composite material. Thus, the results of the conducted electron microscopic studies of crust, semi-finished products and leather for the upper of chrome tanned shoes showed that the microstructure of the dermis of the skin is a complex structure of a fibrous mass. In the process of processing leather processing, there is a large separation of not only the macro-, but also the micro-structure, which is observed in the structure of collagen and the size of the interbeam distances. It was found that the openness of the facial membrane is 10-25% of the area and decreases as the skin is ready. It is quite obvious that the properties of crust and finished leather for the upper of chrome-tanned shoes are influenced by the structural features and interstructural distances of the fibers of the leather tissue of the leather. The conducted electron microscopic studies make it possible to better understand the effect of technological processes and operations on the macro- and micro-structure of the leather, on its porosity and on the physicochemical properties of the resulting leather for the upper of chrome-tanned shoes.



REFERENCES

- 1.I.P. Strakhov et al. "Chemistry and technology of leather and leather." Textbook. M: Legprombytizdat, 1985, 494 p..
- 2.Dubinovsky M.Z., Chistyakova N.B. "Technological leather".Textbook. M: Legprombytizdat, 1991, 320 s.
- 3.Chursin V.I. Modern analytical methods for studying the properties and structure of leather and fur. Laboratory workshop. Publishing house "Lan" 2021
- 4.ODAK kimyevimaddeler [http:// www. odakkimya.net](http://www.odakkimya.net)
- 5.The IULTCS Official Methods of Analysis., 2005 Society of Leather and Chemists, Northampton, U.K.
6. Fiche d'informations 282-12/V2 Quest ATR - A Journey into Performance and Value Site : www.eurolabo.fr Mail : contact@eurolabo.fr
- 7.A. Bykov. Desired and Actual in Geometric Modeling // CAD and Graphics. - M .: Computer Press, 2002. - No. 1



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