Volume 2, Issue 3, March 2024 **ISSN (E):** 2938-3757

TYPES OF POLYMER COMPOSITE MATERIALS AND METHODS OF THEIR USE

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Abstract
Polymer composite materials are a type of engineered composite material that combine a polymer matrix with reinforcement materials. These composites offer a range of desirable properties, including strength, durability, and lightweight characteristics. They are widely used in various industries, such as automotive, aerospace, construction, and more. Let's explore the key aspects of polymer composite materials. The article conducts scientific research on the production of polymer-composite leathers as an alternative to chrome tanning. In particular, methods of tanned tanning (vegetable tanning agents) are being developed.

Keywords: polymer-composite materials, it’s type, metallographic microscopes, contrasting, laser, tanned, modification.

Introduction

As we all know a composite consists of at least two parts, one is reinforcement and the second is the matrix. The composite may contain metals, ceramics, and other polymers as a matrix and as reinforcement. In polymer composite, thermosetting and thermoplastic resins have been used extensively as the matrix. The thermosets are of low viscosity, while thermoplastics have the possibility of recycling and reuse [1-3]. Essentially all commercially important polymers have advance applications. Polymer composites are a rapidly growing industry.

There is a lot of information about polymer materials production technology in general. As an example, it is possible to give new properties to natural leather by changing the surface of the material, applying coatings, and changing the properties of both the decorative and the surface layer. And also genuine leather jewelry competes with jewelry.

Modern processing and also coating methods open up new possibilities for products made of simple genuine leather. Due to the unique nature of the original natural raw material, such as products create a feeling of comfort when wearing.

During the study, an LS-2134D yttrium aluminum garnet laser (LOTIS, Belarus) with a wavelength of 1064 nm was used to process natural skin samples, which was generated in a two-pulse mode (pulses with a time interval of 3 μs separated, stroke duration 10). The accumulated energy was determined by exposure time and ranged from 2 to 15 J. Tanned lambskin was used. First, samples of semi-finished leather products were treated with laser radiation on the front side, and then covered with copper plating. Applied to the skin.

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Method

Applications of Polymer Composite Materials

Polymer composites find applications in various industries due to their unique properties. Some notable applications include:

1. **Automotive Industry:** Polymer composites are widely used in the automotive industry for components such as body panels, interior parts, and structural elements. They offer lightweight solutions, improved fuel efficiency, and enhanced impact resistance 2.
2. **Aerospace Industry:** Polymer composites play a crucial role in aerospace applications, including aircraft structures, engine components, and thermal protection materials. They offer high strength-to-weight ratios, corrosion resistance, and thermal stability 3.
3. **Construction and Infrastructure:** Polymer composites are used in the construction industry for applications such as building structures, bridges, and swimming pool panels. They provide durability, resistance to weathering, and design flexibility.
4. **Oil and Gas Industry:** Polymer composites are utilized in the oil and gas industry for applications like offshore platforms, pipeline repair systems, and drilling operations. They offer corrosion resistance, lightweight properties, and improved performance in harsh environments 4 [4-5].

Advantages and Future Developments

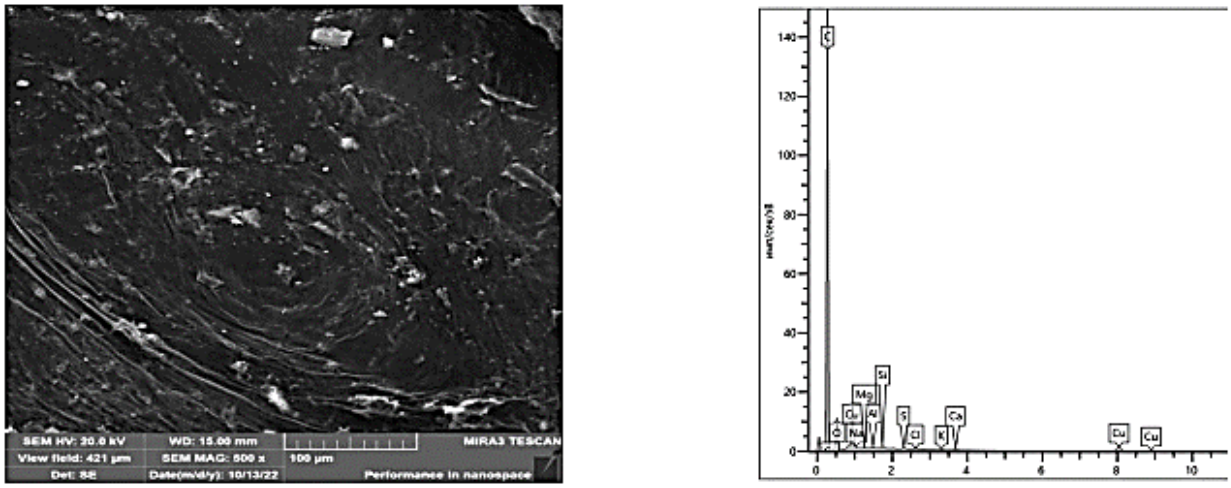
Polymer composite materials offer several advantages over traditional materials, including:

- **Lightweight:** Polymer composites are significantly lighter than metals, making them ideal for applications where weight reduction is crucial, such as in the automotive and aerospace industries.
- **Strength and Durability:** The combination of reinforcement materials and the polymer matrix provides excellent strength and durability, allowing for the construction of robust structures.
- **Design Flexibility:** Polymer composites can be molded into complex shapes, allowing for intricate designs and customization.
- **Corrosion Resistance:** Polymer composites are inherently resistant to corrosion, making them suitable for applications in corrosive environments.

In terms of future developments, researchers are actively exploring the integration of sensing, actuation, computation, and communication capabilities into polymer composites, creating what are known as robotic materials 1. This opens up possibilities for advanced applications in fields such as robotics, healthcare, and smart infrastructure.

Using modern metallographic microscopes

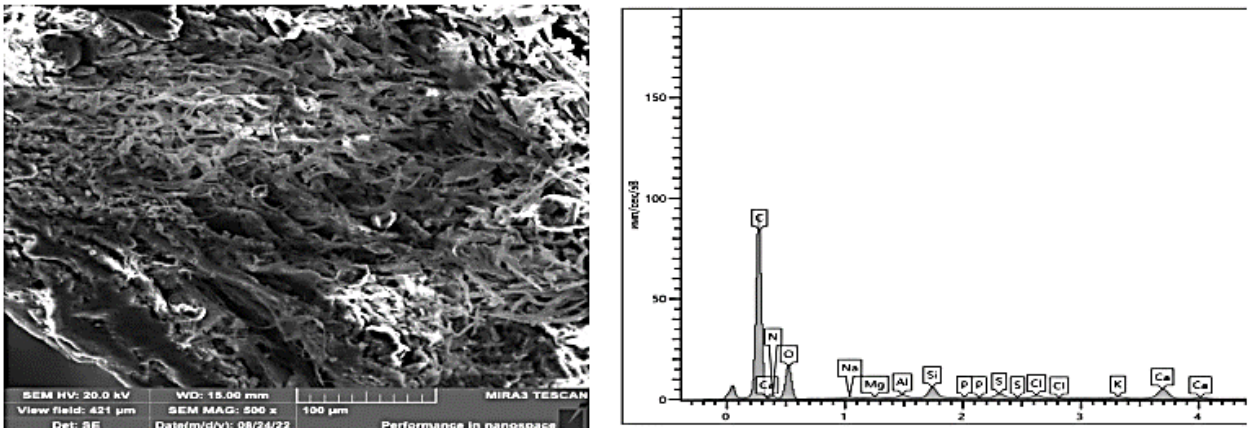
Various optical contrast methods allow studying the structure of non-metallic materials. In this work, MI-1 inverted metallographic microscope was used to study the changes in the morphology of natural leather surface after laser treatment and copper coating [6-8]. The skin surface was analyzed at different magnifications using dark-field illumination. The principle of dark field illumination is that the surface of the sample is illuminated by oblique light rays. The natural color of objects painted in the dark area is preserved.



a b

Figure. 1 Surface morphology (a) and elemental composition of the front surface of polymer-composite leather treatment.

In figure. 1. The surface morphology and elemental composition of the facial surface of the skin using polymer-composite treatment are presented. From the drawings we can see the composition and smooth polymer-composite surface of the skin.



a b

Figure2. a Cross section and b elemental composition of natural leather on a cut.

After laser treatment with an input energy of 40 J and treatment with an antiseptic, and the skin surface does not differ from that without laser treatment. The depth of the hair canal openings was estimated to be 70 µm. Increasing the input laser energy to 60 J does not lead to a significant change in the skin surface. On the subcutaneous tissue side, the surface homogeneity increases.

In picture Figure 3 shows the elemental composition of the sample after laser exposure and subsequent vegetable tanning. Tanned tanning occurs in two stages: diffusion of elements to the active centers of collagen, chemical binding of them to collagen fibers. The chemical composition includes elements of a vegetable tanning solution.

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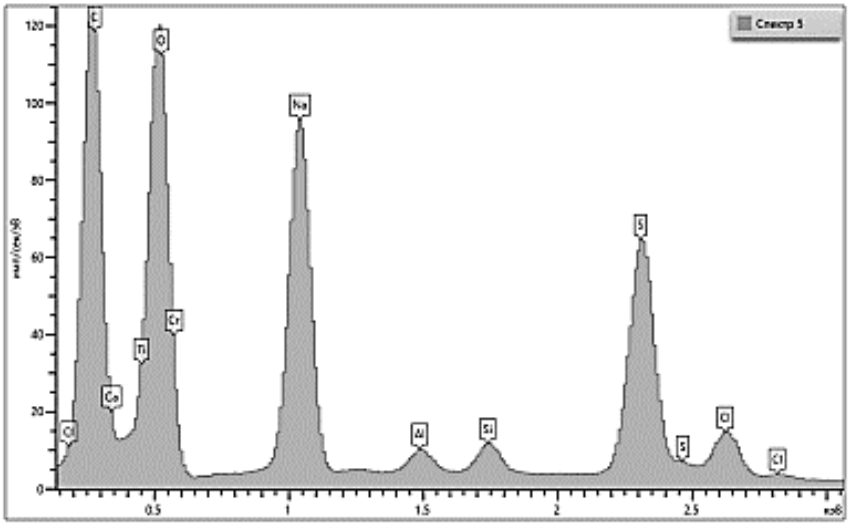

Figure 3. Elemental composition of the sample after laser exposure and subsequent vegetable tanning, input energy 40 J.

Some scientists studied natural leather after modification with polymer-composite materials in the double-pulse laser modification mode in a wide range of input energies. The process of skin ablation using a Co laser has been studied in more detail. The processes of changing the structure of the skin under the influence of an yttrium aluminum garnet laser with a wavelength of 1064 nm, generating in a double-pulse mode, have practically not been studied.

The resulting leathers with an improved facial surface have high physical and mechanical properties. The tanning method we have developed can also be used for leather with a refined front surface.

Conclusion

Polymer composite materials offer a wide range of advantages and find applications in various industries. Their unique combination of strength, durability, lightweight properties, and design flexibility make them a valuable choice for numerous engineering applications. As research and development continue, we can expect further advancements and innovative uses for polymer composites in the future. Polymer composites are typically composed of two main components: a polymer matrix and reinforcement materials. The polymer matrix acts as a binder, holding the reinforcement materials together. The reinforcement materials can be organic or inorganic and are often in the form of fibers or particles.

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