ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-515-x, Impact Factor: 9.23
American Academic publishers, volume 6, issue 01,2026

Journal: https://www.academicpublishers.org/journals/index.php/ijai

ENVIRONMENTAL AND ECONOMIC EFFICIENCY OF LEATHER WASTE RECYCLING

Qozogboyeva Raxnomakhon Odiljon kizi,

PhD Doctoral Student,
Namangan State Technical University

Qayumov Juramirza Abdiramatovich,

Professor, Doctor of Technical Sciences,
Samarkand State University of Architecture and Construction

Abstract. The article analyzes mechanical, chemical, and energy-based methods for recycling waste generated in the leather industry and evaluates their environmental and economic efficiency. The research results show that the implementation of recycling technologies increases production efficiency and reduces environmental impact.

Keywords: Leather waste, recycling technologies, mechanical recycling, chemical recycling, collagen extraction, energy recovery, environmental efficiency, economic efficiency, sustainable production.

The leather industry is one of the important sectors of light industry and is widely used in the production of footwear, clothing, and technical products. However, the leather manufacturing process generates a large volume of solid and liquid waste. Improper management of this waste leads to environmental pollution and negatively affects human health. Therefore, researching effective methods for recycling leather waste is a relevant and urgent issue.

Currently, numerous studies are being conducted on the composition, properties, and environmental impact of organic, mineral, and chemical waste generated during the tanning of natural leather. It has been established that contamination of wastewater from leather production with chromium, sulfides, and other harmful substances adversely affects water resources, soil fertility, and the atmosphere. In addition, scientific research has focused on waste recycling technologies aimed at reducing waste volume and ensuring environmental safety, such as chromium regeneration, production of biogas and fertilizers from organic residues, and biological and chemical wastewater treatment methods.

The scientific and practical significance of this study lies in the fact that the proposed environmental approaches enable the conversion of leather industry waste into valuable resources, contributing to environmental protection and sustainable production.

Research materials and methods

During the research, leather trimmings and technological waste generated at leather manufacturing enterprises were used as samples. The study was conducted using the following methods:

ISSN: 2692-515-x, Impact Factor: 9.23
American Academic publishers, volume 6, issue 01,2026
Journal: https://www.academicpublishers.org/journals/index.php/ijai

- obtaining secondary materials through mechanical shredding and pressing;
- extraction of collagen using chemical hydrolysis methods;
- laboratory tests to determine the energy value of the waste materials.

The obtained results were subjected to statistical analysis and compared with current production performance indicators.



Figure 1. Technological waste at the enterprise

Research results and discussion

As a result of mechanical recycling, the strength of the obtained materials amounted to 60–75% compared to the original leather raw material. This indicator allows their use in the production of shoe soles and technical insulating materials.

During chemical recycling, the efficiency of collagen extraction reached 70–80%. Adhesive and fertilizer samples produced on the basis of the obtained collagen met existing quality standards.

Energy studies showed that the calorific value of leather waste ranges from 14 to 18 MJ/kg. This confirms the possibility of using such waste as an alternative fuel source. According to calculations, recycling can cover up to 20–25% of the enterprise's energy demand.

ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-515-x, Impact Factor: 9.23

American Academic publishers, volume 6, issue 01,2026

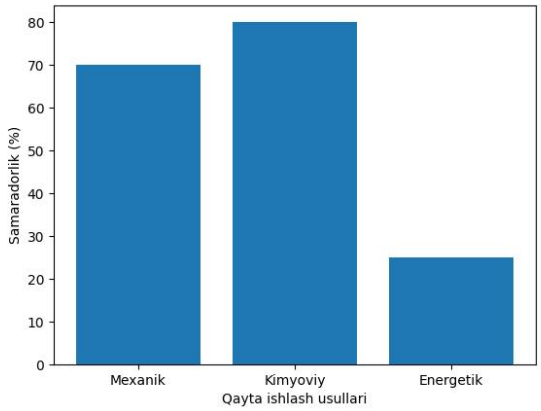
Journal: https://www.academicpublishers.org/journals/index.php/ijai



Figure 2. Waste materials for adhesive production

Recycling Method	Efficiency (%)	Application Area
Mechanical	60–75	Shoe soles
Chemical	70–80	Adhesives, fertilizers
Energy-based	20–25	Thermal energy

Graph 1. Efficiency of recycling methods



ENVIRONMENTAL AND ECONOMIC EFFICIENCY

According to the research results, recycling leather waste reduces the volume of waste by 40–60%, which significantly decreases the environmental burden. Economic analysis shows that the implementation of recycling technologies reduces production costs and creates additional sources of income.

ISSN: 2692-515-x, Impact Factor: 9.23
American Academic publishers, volume 6, issue 01,2026
Journal: https://www.academicpublishers.org/journals/index.php/ijai

Conclusion.The conducted research demonstrates that recycling leather waste is environmentally and economically efficient. Mechanical and chemical recycling methods have been identified as the most promising approaches. Widespread implementation of these technologies in leather industry enterprises will contribute to sustainable development. According to the research findings, leather waste recycling is an effective solution from both ecological and economic perspectives.

References

1. Aliyev A.A. Sanoat chiqindilarini qayta ishlash texnologiyalari. – Toshkent: Fan, 2020.
2. Karimov B.X. Charm sanoatida ekologik muammolar. – Toshkent: O‘zbekiston, 2019.
3. Buljan J., Kral I. Introduction to Leather Processing. – UNIDO, 2015.
4. Covington A.D. Tanning Chemistry: The Science of Leather. – RSC Publishing, 2011.