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ANALYSIS OF ENVIRONMENTAL PROBLEMS IN LEATHER ENTERPRISES AND THE COMPOSITION OF WASTEWATER

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Abstract: This article analyzes the main environmental problems arising in leather manufacturing enterprises, particularly the harmful substances contained in wastewater and their impact on the environment and human health. The leather industry consists of multi-stage technological processes, in which large amounts of water and chemical reagents are used during raw hide preparation, liming, dehairing, chrome tanning, dyeing, and finishing. As a result, wastewater contains chromium compounds, sulfides, chlorides, organic substances, fats, proteins, and highly mineralized pollutant components. The article considers the possibilities of reducing these problems through mechanical, chemical, biological, and membrane-based wastewater treatment methods.

Keywords: leather industry, environmental problem, wastewater, chromium, sulfide, organic pollution, treatment technology, environmental protection.

The leather industry is one of the important branches of light industry, producing natural leather products required for footwear, clothing, leather goods, furniture, and the automotive industry. At the same time, this industrial sector is considered one of the environmentally hazardous areas of production. The main reason for this is the use of large amounts of water, chemicals, salts, acids, alkalis, dyes, and tanning reagents in the leather manufacturing process.

Wastewater discharged from leather enterprises contains biodegradable and hardly biodegradable organic substances, heavy metals, especially trivalent chromium compounds, sulfides, chlorides, and high levels of dissolved substances. If such wastewater is released into the environment without adequate treatment, it can lead to contamination of soil, groundwater, and open water bodies.

Sources of Pollution in Leather Manufacturing Processes: Leather production consists of several main stages. At each stage, various pollutants enter the composition of wastewater.

The first stage is the soaking of raw hides. During this process, salt, blood, dirt, dissolved proteins, and mechanical impurities from the hides pass into the water. As a result, the amount of organic matter in the wastewater increases.

The second stage is the liming and dehairing process. At this stage, lime, sodium sulfide, and other chemical substances are used. This process is the main cause of increased sulfides, alkaline substances, and protein decomposition products in the wastewater.

The third stage is the tanning process. In many leather enterprises, chrome tanning technology is used. During this process, a certain portion of chromium salts is absorbed into the leather, while the remaining part passes into the wastewater. Chromium compounds may accumulate in the aquatic environment and pose an ecological risk.

The fourth stage is the dyeing and finishing process. At this stage, dyes, surfactants, fatliquoring agents, and auxiliary reagents are used. These substances increase the color intensity, chemical oxygen demand, and toxicity level of the wastewater.

Composition of Wastewater: Wastewater from leather enterprises has a complex chemical composition. The following main components are commonly found in its composition:

Components in the Composition of Wastewater

Table 1

№	**Pollutant**	**Source**	**Environmental Impact**
1.	Chromium compounds	Tanning process	Accumulate in water and soil and have a toxic effect
2.	Sulfides	Dehairing process	May form toxic gases
3.	Chlorides	Hide salting and soaking	Increase the mineralization of water
4.	Organic substances	Protein, fat, and blood residues in hides	Lead to a decrease in dissolved oxygen in water
5.	Dyss	Dyeing process	ncrease the color intensity of water and negatively affect the biological environment
6.	Fats and oils	Fatliquoring process	Form a film on the water surface and limit oxygen exchange

The main quality indicators of wastewater include pH, biochemical oxygen demand, chemical oxygen demand, total dissolved solids, suspended particles, chromium, sulfide, and chloride content. High values of these indicators show that wastewater cannot be discharged directly into water bodies.

Environmental problems in leather enterprises are manifested in several directions. First, wastewater pollutes water resources. Organic substances contained in wastewater lead to a decrease in the amount of oxygen in water bodies. This negatively affects aquatic organisms.

Second, chromium and other heavy metals may accumulate in the soil. Such substances can enter the food chain through plants and pose a risk to human health.

Third, sulfide-containing wastewater can form hydrogen sulfide gas in an acidic environment. This gas has a strong odor and is toxic, negatively affecting enterprise workers and the population living in nearby areas.

Fourth, leather enterprises generate solid wastes such as wool, flesh residues, leather trimmings, and chromium-containing sludge. Improper storage or disposal of these wastes may cause secondary contamination of soil and groundwater.

Wastewater Treatment Methods An integrated approach is required for the effective treatment of wastewater from the leather industry. It is difficult to completely remove all harmful substances using only one method. Therefore, it is advisable to apply mechanical, chemical, biological, and modern physicochemical methods in combination.

During mechanical treatment, large particles, wool, leather pieces, and suspended solids are separated from wastewater. Screens, grit chambers, settling tanks, and filters are used for this purpose.

Chemical treatment involves coagulation, flocculation, neutralization, and chromium precipitation processes. For example, chromium compounds can be removed from wastewater by precipitating them in the form of hydroxides.

Biological treatment is based on the decomposition of organic substances by microorganisms. This method is considered effective for treating wastewater with a high biochemical oxygen demand.

Modern methods such as membrane technologies, adsorption, and ion exchange are applied at the advanced treatment stage. These methods help reduce dissolved salts, coloring substances, and heavy metal ions in water.

Recommendations for Reducing the Problem To reduce environmental risks in leather enterprises, the following measures should be implemented: Introduction of closed-cycle technologies that reduce water consumption.

Efficient use of reagents in the chrome tanning process.

Establishment of a system for chromium recovery and its return to the production process.

Use of environmentally safe reagents that reduce sulfide content.

Development of a step-by-step wastewater treatment system.

Separate collection, recycling, and safe disposal of solid wastes.

Regular implementation of an environmental monitoring system in enterprises.

Conclusion: Although the leather industry is economically important, it is one of the production sectors with a high level of environmental risk. Wastewater generated during raw hide processing contains chromium, sulfides, chlorides, organic substances, fats, and dyes, which have a negative impact on water, soil, and the atmosphere. Therefore, in leather enterprises, in-depth analysis of wastewater, improvement of treatment technologies, and the introduction of waste-free or low-waste production systems are considered urgent tasks.

For environmentally safe leather production, it is necessary to apply modern treatment methods, resource-saving technologies, and recycling systems. This serves not only to protect the environment but also to ensure that enterprises operate in accordance with international environmental standards.

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