VI. INTERNATIONAL CONGRESS OF CULTURAL LANDSCAPES WITHIN THE FRAMEWORK OF SUSTAINABLE DEVELOPMENT

Culture-Landscape-History-Archeology-Art

Amasya, Türkiye

November 13-14, 2025

CONFERENCE PROCEEDINGS BOOK

Editors

Prof. Dr. Öner DEMİREL

Prof. Dr. Atila GÜL

Assoc. Prof. Dr. Sultan Sevinç KURT KONAKOĞLU

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IMPROVING THE ENVIRONMENTAL SAFETY OF WATER DEMINERALIZATION USING MAGNETICALLY ACTIVATED ION EXCHANGE

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ABSTRACT

The process of demineralization of natural water, which is used to obtain high-purity water, has a number of environmental risks associated with the use of chemicals, the formation of concentrated wastewater, and energy consumption. Ion exchange and reverse osmosis, which are the main methods of demineralization, involve the use of significant amounts of reagents such as acids, alkalis, and regeneration solutions. Their improper disposal or leakage can cause contamination of soil and aquatic ecosystems, altering the natural chemical balance. Demineralization produces highly mineralized wastewater (concentrates) containing significant amounts of removed salts and impurities. Discharging them into natural water bodies without proper treatment can lead to an increase in osmotic pressure in the aquatic environment, which negatively affects aquatic organisms, causing their dehydration or death. The main methods of discharge and disposal of such concentrates are:

1. Discharge into sewage systems — subject to compliance with regulatory requirements, concentrates can be discharged into municipal or industrial wastewater. Before this, neutralization (addition of acid or alkali to normalize pH) and dilution are carried out to reduce the negative impact on treatment facilities.

2. Evaporation and crystallization - in some cases, the technology of evaporating water from the concentrate is used to obtain dry salt residues that can be disposed of or used in industry (for example, in the production of reagents or building materials).

3. Discharge into water bodies — only possible after pre-treatment, if environmental standards allow. In this case, the concentrates are diluted to safe concentrations or undergo additional treatment.

4. Injection into deep underground layers — in some regions, concentrates are injected into geological formations that do not come into contact with drinking water. This is an expensive but environmentally safe method.

5. Use in production processes — for example, sodium chloride concentrates can be used in salt production, and concentrated sulfate solutions can be used in the chemical industry.

Demineralization is an energy-intensive process that increases greenhouse gas emissions and contributes to environmental change. Therefore, it requires environmentally safe technologies to minimize waste, reuse water, and improve energy efficiency. The problem of water availability for the population requires the improvement of water treatment systems. It is necessary to reduce the impact on the environment, the demineralization process, and achieve effective treatment, ensuring the availability of usable water for the population. To improve the efficiency and environmental safety of ion exchange processes, a method has been proposed that involves the use of modified ion exchangers with simultaneous exposure of the ion exchange bed and the water to be purified to a magnetic field. This approach eliminates the main drawback of the traditional magnetic purification method, which is related to the limitation of its application in conditions of high-water hardness. The use of magnetic activation contributes to the intensification of mass transfer processes, increases the efficiency of desalination, and ensures the stable operation of ion exchange systems. The proposed method is consistent with current state policy in the field of rational use and protection of water resources in Ukraine, which is based on the principles of sustainable development, resource conservation, and environmental safety.