

HYDROCHEMICAL CHARACTERISTICS AND ENVIRONMENTAL ASSESSMENT OF GROUNDWATER

N.A. Uteniyazova

Berdakh Karakalpak State University, Republic of Karakalpakstan, Uzbekistan.

E-mail: naubakhar.1991@gmail.com

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Abstract. *This thesis examines the hydrochemical characteristics of artesian groundwater and assesses its environmental condition in the Chimbay, Karauzyak, and Takhtakupyr districts of the Republic of Karakalpakstan. The chemical composition, degree of mineralization, hardness, salinity, pH, and heavy metal concentrations of groundwater are important parameters for a comprehensive assessment of water quality. Comparing these parameters with sanitary and hygienic standards makes it possible to identify potential environmental risks associated with drinking water supply and to develop measures for the rational use of water resources.*

Keywords: *groundwater, artesian groundwater, hydrochemical properties, mineralization, water hardness, heavy metals, environmental assessment, drinking water.*

Introduction. Groundwater is one of the most important natural resources for providing the population with drinking water. Its quality is determined by a combination of factors, including geological and hydrogeological conditions, the mineralogical composition of rocks, groundwater exchange processes, and anthropogenic influences. The concentrations of dissolved mineral substances and various chemical elements in groundwater determine its physicochemical properties.

Therefore, investigating the hydrochemical characteristics of groundwater in the Chimbay, Karauzyak, and Takhtakupyr districts of the Republic of Karakalpakstan is of particular scientific and practical importance. A comprehensive analysis of the degree of mineralization, salinity, hardness, and chemical composition of groundwater is necessary to assess the quality of drinking water in these areas.

In particular, determining the concentrations of lead, cadmium, and other potentially hazardous elements is essential for evaluating whether the water meets sanitary and hygienic requirements. The environmental assessment of groundwater should not be limited to determining individual chemical parameters.

It should also take into account the hydrogeological characteristics of the water source, sampling conditions, analytical results, and the applicable drinking water quality standards.

Aim of the Study. The aim of this study is to investigate the hydrochemical characteristics of artesian groundwater in the Chimbay, Karauzyak, and Takhtakupyr districts of the Republic of Karakalpakstan, determine the key water quality parameters, and assess its environmental condition in accordance with sanitary and hygienic standards.

Materials and Methods: The groundwater sources used for drinking purposes in the Chimbay, Karauzyak, and Takhtakupyr districts were selected as the objects of this study.

Laboratory analyses of the water samples are intended to assess the parameters presented in Table 1 below.

№	The following parameters will be assessed through laboratory analysis of the water samples.
1	Organoleptic characteristics: color, odor, and taste.
2	Physicochemical parameters: pH, total mineralization, and water hardness.
3	Major ions: calcium, magnesium, sodium, bicarbonates, chlorides, and sulfates.
4	Potentially hazardous chemical elements: lead, cadmium, copper, and other elements.

The study may employ laboratory analyses, comparative assessment, systematization of hydrochemical data, and environmental analysis methods. The results obtained are compared with the relevant sanitary and hygienic standards. Standardized methods and appropriate quality control procedures must be followed during water sampling and analysis.

Results and Discussion: The hydrochemical characteristics of groundwater are primarily assessed based on its mineralization level, total hardness, and the ratios of major ions. An increase in mineralization may indicate a higher concentration of dissolved salts in the water. However, it is not appropriate to determine the suitability of water for drinking purposes solely on the basis of its total mineralization. The concentrations of individual ions and chemical elements must also be assessed. Water hardness is determined primarily by the concentrations of calcium and magnesium ions, which affect its technological and domestic properties. The concentrations of chloride, sulfate, and sodium provide important information about the ionic composition of water. The determination of heavy metal concentrations is a key component of environmental assessment.

In particular, comparing lead and cadmium concentrations with the applicable regulatory limits helps identify potential risks to water quality. It is essential to verify the accuracy of laboratory results, the units of measurement, and the specific regulatory standards used for comparison. According to the previously provided laboratory data for the artesian well serving the Agitay Adilov settlement, located on Toza Makon Street in Takhtakupyr District, the total dissolved solids concentration was 678 mg/L, the pH was 7.5, and the total hardness was 9.0.

Furthermore, the lead concentration was measured at 0.032 mg/L. If the measurement units are confirmed by the laboratory report and the applicable regulatory limit is 0.03 mg/L, the measured concentration slightly exceeds this limit. This finding highlights the need for confirmatory laboratory testing and continued monitoring of the well water quality. However, the results of a single water sample are insufficient to draw general conclusions about the environmental status of groundwater throughout the district or across all artesian wells. A reliable assessment requires collecting samples from multiple water sources in each district, conducting repeated laboratory analyses, and evaluating spatial and seasonal variations in water quality.

Therefore, a scientifically sound assessment of the environmental status of groundwater in the Chimbay, Karauzyak, and Takhtakupyr districts requires a comprehensive analysis of

hydrochemical parameters, comparison of analytical results with applicable regulatory standards, and systematic monitoring of groundwater sources.

Conclusion: The study of the hydrochemical characteristics of groundwater is essential for assessing its quality and determining its suitability for drinking purposes. A comprehensive analysis of mineralization, hardness, pH, major ions, and heavy metal concentrations enables well-founded conclusions to be drawn regarding the environmental status of groundwater. Regular hydrochemical monitoring of groundwater in the Chimbay, Karauzyak, and Takhtakupyr districts of the Republic of Karakalpakstan is recommended. Laboratory analyses should be performed using standardized methods, and the results should be compared with the applicable sanitary and hygienic standards. Based on the results obtained, measures can be developed to improve the quality of water sources, reduce potential environmental risks, and provide the population with high-quality drinking water.

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