

TƏBİƏT ELMLƏRİ  
NATURAL SCIENCES

## Microbiological Application of Groundwater of Shamkir Administrative Region

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**Abstract.** Groundwater constitutes the main part of the total water resource and is collected under favorable geological-structural conditions, so it is considered appropriate to call such areas "groundwater reservoirs". In general, groundwater reservoirs (GWR) are areas where groundwater accumulates under the influence of natural and artificial factors, ensuring the economic efficiency of its use in the national economy in terms of quantity and quality. As mentioned above, groundwater is formed as a result of the influence of natural and artificial factors.

An artificial groundwater is formed by the artificial transfer of surface water underground when it is located in favorable geological-structural and lithological conditions or by the accumulation of water as a result of losses from the water supply system, as well as through filtration from canals and reservoirs. The fact that groundwater is located in natural conditions and replenishes its reserves as it is exploited distinguishes it from other minerals (ores and non-ores, oil, gas).

**Keywords:** groundwater, geological-structural factors, hydrogeological factors, pollution sources, Shamkirchay reservoir

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## Şəmkir inzibati rayonunun qrunut sularının mikrobioloji tətbiqi

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**Xülasə.** Qrunut suları ümumi su ehtiyatının əsas hissəsini təşkil edir və əlverişli geoloji-struktur şəraitdə toplanır, ona görə də belə sahələrin "qrunut su anbarları" adlandırılması məqsədəuyğun hesab olunur. Ümumiyyətlə, yeraltı su anbarları (QSH) təbii və süni amillərin təsiri altında qrunut sularının toplandığı, ondan kəmiyyət və keyfiyyət baxımından xalq təsərrüfatında istifadəsinin iqtisadi səmərəliliyini təmin edən ərazilərdir. Yuxarıda qeyd edildiyi kimi, yeraltı sular təbii və süni amillərin təsiri nəticəsində əmələ gəlir.

Süni qrunut suları əlverişli geoloji-struktur və litoloji şəraitdə yerləşdiyi zaman yeraltı suların süni şəkildə ötürülməsi və ya su təchizatı sistemindən itkilər nəticəsində suyun toplanması, o cümlədən kanallardan və su anbarlarından filtrasiya yolu ilə əmələ gəlir.

*Qrunt sularının təbii şəraitdə yerləşməsi və istismar olunduqca ehtiyatını artırması onu digər faydalı qazıntılardan (filiz və qeyri-filiz, neft, qaz) fərqləndirir.*

**Açar sözlər:** yeraltı sular, geoloji-struktur amillər, hidrogeoloji amillər, çirklənmə mənbələri, Şamkirçay su anbarı

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## Introduction

Fields of great practical importance are called industrial-type fields. These are hydrogeological objects that in practice provide water supply to large cities, industrial centers, including large irrigation areas. Like all other mineral deposits, the GWR has conditional boundaries both in plan and in section. The exploitation reserve of groundwater for industrial-type GWR can be conditionally taken as 5-10 thousand m<sup>3</sup>/day. Fields with a small water reserve are classified as small objects and are considered non-industrial groundwater deposits. Aquifers that play a key role in the creation of exploitable groundwater reserves in centralized water supply within the field boundary are called "productive". The main factors determining the regularities of the formation of the industrial type of groundwater are the following:

- 1) *Geological-structural factors* determine the conditions of formation and deposition of water-bearing rocks, their lithological composition, their filtration properties, the interaction of various water horizons, etc.;
- 2) *Hydrogeological factors* determine the hydrodynamic regime of groundwater flow, feeding and discharge conditions, the formation of its chemical composition, including the impact of groundwater exploitation on the environment, etc.;
- 3) *Geomorphological factors* determine the conditions of formation of a productive water horizon, including the filtration properties of water-bearing layers and the interlayers separating them;
- 4) *Hydrological factors* determine the conditions of the interaction of groundwater and surface waters – the feeding of groundwater due to filtration from surface waters;
- 5) *Climatic factors* determine the conditions of natural recharge of groundwater due to infiltration of atmospheric sediments, their natural discharge due to evaporation, plant transpiration, etc.;
- 6) *Technical factors* determine the possibilities of applying a technically and economically efficient water supply for the exploitation of groundwater.

## Methods

Microbiological research of groundwater of Shamkir administrative district and practical application of these studies are of great importance for assessment of drinking water supply and ecological condition of the region. Underground water resources of the Republic of Azerbaijan, including Shamkir district, are considered one of the main sources of water supply for the population. The main aspects related to the microbiological status of groundwater in the Shamkir region are as follows:

*Monitoring and Quality:* Groundwater monitoring networks have been restored in the Kura River basin and surrounding areas, including Shamkir district, and regular analytical studies are being conducted at these sites. These studies allow assessing the sanitary and microbiological indicators of groundwater (e.g., E. coli bacteria, total microbial count).

*Pollution Sources:* Microbiological pollution of groundwater can be affected, in particular, by agricultural activities (intensive agriculture, livestock breeding), wastewater from settlements, and household waste. Intensive agriculture (vegetable farming) in Shamkir district is one of the factors affecting the quality of groundwater.

*Application Areas:* The results of microbiological studies are used to determine the suitability of groundwater for drinking water, select water disinfection methods, and divide water sources into protection zones.

*Research Objectives:* These studies aim to prevent water-borne diseases and maintain the ecological balance of water resources. In general, microbiological monitoring of groundwater in the Shamkir region is an important measure to ensure that water quality complies with international and local standards (Sanitary norms and rules).

## **Results**

The earthen dam of the Shamkirchay reservoir hydroelectric power station consists of a clay-containing core in the center, a three-layer filter layer around the core, a gravel-crushed stone and a broken stone-rock fill sorted from fine sand soil, and the lower and upper parts of the body are built of large stone and shale fill. Since the materials in the earthen dam body up to the clay core and after the core are completely permeable, there will be no drop in the level of water seeping from those parts of the dam on the surface (Musayev et al., 2009; Ash, 2019; Kourik, 2020; Məmmədov & Musayev, 2006; Solomon, 2017).

The fall curve of the water seeping through the body of the earthen dam is obtained only inside the trapezoidal clay core. Considering that the water depth in front of such a dam is  $H$ , and the water depth on the downstream side is  $h_0$ , the inner part of the body necessitates new calculations. When the corresponding values of the ordinates of the water seeping through the clay core at the inlet and outlet are  $H$  and  $h_0$ , the calculations are carried out by assuming the ordinate  $h_0$  at the origin of the coordinate to construct the fall curve (Məmmədov et al., 2008; İsmayılov & Süleymanov, 2016; Məmmədov et al., 2006).

Water flow rates are formed due to rain and snow waters, which are more characteristic for the region. It was considered expedient to regulate the water flow rates released from the reservoir for many years. The high rainfall in these areas from April, May, September, and October of the year causes the groundwater level to rise. The rise in groundwater levels, along with increasing water flow rates, has created certain ecological problems at the base of the earthen dam and in the lower by-bank. These problems include the acceleration of pressure seepage at the base of the earthen dam, washing out of the plastically fluid part of the soil, suffocation, erosion, and other problems.

In the water-bearing part of the hydro-junction, the slopes are formed from soils with silt, sand, clay, sand, large crushed stone and large-sized stone piles. The natural layer-by-layer settlement of these soils along the slopes creates conditions for water leakage from soil layers consisting of large solid particles (stones). Pressure water leakage from such soil layers can result in gradual or strong water losses from the reservoir, landslides of part of the natural slopes and suffosis at the base of the earthen dam (Melinda, 2021; Aliyev, 2009; Elmo, 2019; Musayev & Məmmədov, 2001).

The soils in the irrigation areas and at the base of the dam are saline. The process of pressure seepage causes these salts to be washed away and transported from one place to another, changing the ecological environment. Therefore, it is very important to deeply investigate and analyze the effects of seepage flow at the base of the dam and downstream.

Before the construction of the earthen dam of the reservoir, it was determined that the location area in the plan consisted of highly impermeable soils. In order to strengthen the preparatory layer of the earthen dam base, the highly impermeable soil parts were cut and removed from that area along with the vegetation layer. By placing a groove of the same material under the clay core in the central part of the dam, other impermeable zones in the base were also limited to some extent.

## Discussion and Conclusion

The composition of waters in nature varies depending on their origin, relief, natural climatic conditions, chemical and physical properties. This difference also affects their microbiological state. Therefore, it is important to consider the intended use when using water. The requirements for water quality also vary depending on the areas of use. Therefore, the degree of usefulness of water, especially its microbiological state, should be taken into account when using it for its intended purpose. The quality of water depends on its temperature, the type of mineral residues in its composition, the concentration of organic substances, the amount of oxygen, toxic substances, the quantitative and qualitative indicators of pathogenic microbes, etc. If the concentration of organic substances in the water is excessively high, it causes a bad smell from the water, changes the color and taste of the water, and such water is considered unsuitable for drinking. Drinking water is constantly monitored by the state and for this purpose, periodic monitoring is carried out, and water is released to the population only after passing bacteriological and virological examination.

The health of the human body depends largely on the purity of the water used. When using water in industry, it must be taken into account that it does not have a negative impact on the people working there, the products produced, and the equipment and devices used. In agriculture, water used for irrigation should not harm plants and soil, and water used in livestock farming should not harm the health of animals.

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