Analysis of Physical-Chemical Parameters of Takhtakorpu-Ceyranbatan Canal Water

Sarvan Panahov[1]

[1]Department of Ecology and Environment, Western Caspian University, Baku, Azerbaijan

Received: 03.09.2025 Accepted: 18.10.2025 Published:25.11.2025

https://doi.org/10.54414/CCXZ4485

Abstract

The Takhtakorpu-Jeyranbatan Canal is a strategic link in the water supply chain of the Absheron Peninsula: the ionic composition, mineralization level, and acidity-alkalinity balance of water along the course directly affect both the stages of drinking water treatment and the use of water for irrigation purposes. In this study, the physicochemical parameters of a water sample taken from the Jeyranbatan Canal (Baku, Jeyranbatan settlement) were analyzed based on a laboratory report, and the results were compared with the standard parameters (WHO, AI, GOST, and Absheron average parameters) presented for the Jeyranbatan reservoir. The analysis includes major ions (HCO_3^-, Cl^-, Na^+, K^+), total hardness, pH, electrical conductivity (EC), total dissolved solids (TDS) and dry residue indicators. The results show that the mineralization of the water according to the selected parameters is at a medium-low level, and the chloride and sodium concentrations are in line with both the limits given for drinking water and the classification criteria for irrigation water. At the same time, given the seasonal variability across the system and the fact that some biogenic indicators (e.g. ammonium/nitrite) may be elevated at individual locations, it is considered risky to limit monitoring to "major ions". In this context, the analysis both evaluates current results and provides a reasoned approach to optimizing measurement frequency and indicator selection from a management perspective.

Keywords: Physico-chemical parameters, water reservoir, water channel, drinking water, safety

1. Introduction

Water is one of the most important and vital chemical compounds for the population. Water is a major component of both plants and animals, as well as the human body. 60-95% of the mass of plants and animals, and 60-70% of the mass of the human body, consists of water. Although 71% of the world is covered in water, 97.5% of it is salt water. Fresh water is difficult to use because some of it is in polar ice caps and some is deep underground. The amount of surface water available for drinking is only 0.3%. In Azerbaijan, reservoirs are mainly used to meet the demand for drinking water. One of them is the Jeyranbatan reservoir, which meets the drinking water needs of Baku and the Absheron Peninsula, where the country's population is more densely populated. The Jeyranbatan Reservoir was created in natural conditions, is 9.1 km long, 2.1 km wide, has an area of 13.90 km², and a volume of 0.186 km³. The main source of nutrition for the reservoir is the Samur-Absheron Canal, which originates from the Samur River. The Takhtakorpu Reservoir was built on the canal to eliminate the limitation in supplying water from the Samur River to this canal, the dependence on the country through which the Samur River passes, and to regulate the changes in water during seasonal changes. In addition, in order to increase the water supply of the reservoir, a certain part of the water of the Gusarchay, Gudyalchay, Guruchay, Agchay, Jagajugchay and Velvelachai rivers in the region is discharged into the reservoir through the Velvelachai-Takhtakorpu canal, which is part of the Samur-Absheron canal system. The water collected in the Takhtakorpu reservoir is transferred to the Jeyranbatan reservoir through its own flow through the Takhtakorpu-Ceyranbatan canal. The length of the Takhtakorpu-Ceyranbatan canal is 112 km, the slope coefficient is 1.5, the inclination is 0.0003, the bottom width is 4 m, the water depth is 3.12 m, the flow rate is 40 cubic meters per second, and the flow speed is 1.48 m per second (Pashayev & Hasanov, 2010, p.5).

The Takhtakorpu–Jeyranbatan aqueduct system is not only a hydraulic infrastructure, but also a route through which “quality is transported”: the chemical composition of water can change under the geochemical background of source waters, along-stream mixing, seasonal flow regime, and anthropogenic influences. These changes are especially important in terms of reliable drinking water supply on the Absheron Peninsula. The Jeyranbatan reservoir is fed by the Samur-Absheron canal, and the water processed here plays a major role in the supply of Baku and Sumgait, as well as a number of administrative territories of Absheron; water quality requirements are moving towards harmonization with regional standards as well as international norms.

The expansion and modernization of this system from an engineering perspective also makes the issue of water quality a more “manageable” issue: components such as the construction and financing of the Velvelechay-Takhtakorpu canal within the Samur-Absheron projects have served precisely to ensure the sustainability of water supply. Since the channel-storage-processing line operates as a whole, quality decisions must be made as a whole: which parameter changes faster, which indicator plays the role of an “early signal”, at what stage does the risk increase – the answer to these questions is formed by the correct selection and interpretation of monitoring data (AGROLAB, 2025).

Hydrochemical studies conducted on the Takhtakorpu-Ceyranbatan canal and related water bodies show that mineralization and hardness vary depending on the season and location, that the water moves in the interval from “soft to medium hardness” and that mineralization generally remains within a satisfactory range; however, it is emphasized that there are zones prone to pollution along the stream and that some indicators may increase in certain periods (Ganbarov, et al., 2020, p.17). This requires evaluating the indicators measured on a specific sample with a systemic approach, rather than as a "one-time good result."

The purpose of this article is to interpret the physicochemical parameters of a sample taken from the Jeyranbatan canal based on laboratory results, compare the results with the normative comparison framework presented for the Jeyranbatan reservoir, and assess the risks (corrosion-sedimentation potential, salinity/soda tendency, taste-organoleptic impact probability) from a practical perspective in a general logical chain (AGROLAB, 2025).

2. Theoretical foundations of the study

80% of diseases in the world are caused by poor water quality. Considering that water enters the Takhtakorpu-Ceyranbatan canal from various sources, it can be noted that the physicochemical composition of this water is variable and heterogeneous. As a result of the combination of waters from sources with different hydrological, geological, and anthropogenic characteristics, the pH, degree of mineralization, hardness, and other physicochemical parameters of the water along the canal acquire different characteristics. This causes the composition of the water of the Takhtakorpu-Ceyranbatan canal to be complex and diverse. The cause of 80% of diseases spread in the world is due to poor water quality. For example, high levels of lead entering the human body damage the nervous system, brain development, and cause kidney diseases (Ganbarov, et al., 2020, p.19)

3. Sample and measurement framework

The main source of information for the analysis is the test report on the water sample received from the “AGROLAB” Agricultural Testing Laboratory (Report No. Sa-020/25). The area where the sample was taken is indicated as Jeyranbatan Canal (Baku city, Jeyranbatan settlement); the sample was taken on 04.12.2025, the analysis was conducted on 08.12.2025, and the report was compiled on 09.12.2025 (AGROLAB, 2025).

4. Measured parameters

The report provides results for the following indicators: hydrocarbonate (HCO_3^-), chloride (Cl^-), total hardness (Ca^{2+} and Mg^{2+}), sodium (Na^+), potassium (K^+), pH, electrical conductivity (EC), TDS, and dry residue.

5. Analytical methods

The laboratory report specifies the methods according to GOST standards: determination of chlorides (GOST 4245-72), determination of hydrocarbons (GOST 23268.3-78), determination of total hardness (GOST 31954-2012), determination of EC and pH (GOST 26423-85), dry residue (GOST 18164- 72), potassium (GOST 23268.7-78) and sodium (GOST 23268.6-78) (Gidayatzade, 2022).

6. Comparison base and normative framework

The comparison is based on two directions:

1. Maximum permissible limits for drinking water given in the report (such as 200 mg/L for Na, 10 mg/L for K, 1000 mg/L for dry residue, and a pH range of 7–8).
2. Table presented for the Jeyranbatan reservoir: The norms of various organizations (WHO, European Union, GOST) and the average indicators for the Absheron Peninsula are compared in the same table (for example, 250 mg/L (WHO/EU) for Cl^-, 350 mg/L (GOST), 2500 µS/cm in the EU for EC, 6.5–8.5 in the WHO for pH, etc.).

The initial assessment for irrigation purposes was conducted based on the "irrigation water quality classification" criteria (class I–III) given in the laboratory report (Gidayatzade, 2022).

Overall result table

The table below summarizes the results for the example and the key thresholds used for comparison.

Table 1.

Parameter	Unit	Result (canal water)	Permissible Limit for Drinking Water	WHO/Aİ/GOST (Jeyranbatan comparison table))
pH	—	7.67	7–8	6.5–8.5 (WHO), 6–9 (Aİ)
EC	mS/cm	0.66 (≈660 µS/cm)	<2.5	2500 µS/cm (Aİ)
TDS	mg/L	330	1500	—
Dry residue	mg/L	665	1000	—
HCO_3^-	mg/L	116	300	— (presented separately in the table))
Cl^-	mg/L	78	350	250 (WHO/Aİ), 350 (GOST)
Total hardness	mg/L ($CaCO_3$)	54 (≈1.08 meq/L)	350	1.2 meq/L (Aİ), 7 meq/L (GOST)
Na^+	mg/L	115	200	—
K^+	mg/L	4	10	—

The results in the table was taken from the laboratory report.
The normative comparison indicators are based on the table fragment presented for the Jeyranbatan reservoir.

7. Mineralization and salinity indicators: EC, TDS and dry residue

Mineralization is a group of key indicators that characterize the “total load” of water. In practice, EC (electrical conductivity) is considered a “operational indicator” that is quickly measured, since it is directly related to the ionic composition of water; TDS and dry residue act as different measurement approaches to the same process. The EC in the sample is at 0.66 mS/cm (approximately 660 µS/cm). This figure is significantly lower than the 2500 µS/cm given for the EU in the comparison table for the Jeyranbatan reservoir (GOST, 1982). TDS was measured at 330 mg/L and dry residue at 665 mg/L. Since the maximum permissible limit for drinking water in the report for dry residue is 1000 mg/L, the result of 665 mg/L remains within this limit. The same logic applies to TDS: 330 mg/L against the 1500 mg/L limit indicates a low mineralization level (Ganbarov, et al., 2020, p.18). To understand these results on a more "systemic" scale, it is useful to look at the hydro-chemical ranges along the Takhtakorpu–Ceyranbatan canal. The relevant hydrochemical study shows that the normal mineralization for the Takhtakorpu-Ceyranbatan canal varies in the range of approximately 312.3–461.2 mg/L. The TDS output of 330 mg/L in the sample coincides with the lower part of that interval and can be interpreted as a fit indicating that the overall background of mineralization in the channel has stabilized in the "low–medium" range. At the same time, the fact that the dry residue indicator is higher than the TDS increases the possibility of differences in measurement approaches (for example, some non-volatile fractions have a greater share in the dry residue, while the TDS is given as an instrument calculation); such differences increase the need for method unification when comparing between systems. Regarding the risk of irrigation in terms of salinity, the value of 0.66 mS/cm for EC in the laboratory classification falls within the class I range (<0.75) (GOST, 1982). This can be taken as a "sign" that the risk of salt accumulation in the soil is low at an early stage. The key point here is that the risk in irrigation is not limited to EC alone: the relative share of sodium, the mechanical composition of the soil and the irrigation regime are equally crucial. Therefore, while a good EC output creates a positive background, maintaining a wide range of control parameters is a more sound approach (IWRA, 2018).

8. pH and Hydrocarbonate: acidity-alkalinity balance and stability

pH is one of the main parameters indicating the acidity-alkalinity environment of water and affects the risks of both corrosion and sedimentation (e.g. carbonate deposits). In the example, the pH is 7.67. This value corresponds to the range of 7–8 given in the report for drinking water. At the same time, the comparison table for the Jeyranbatan reservoir gives ranges of 6.5–8.5 for WHO and 6–9 for EU, with 7.67 being in the central part of these ranges. Hydrocarbonate (HCO_3^-) was measured at 116 mg/L. Hydrocarbonate forms the alkalinity reserve of water and helps to keep the pH "constant"; therefore, the combination of pH 7.67 and HCO_3^- 116 mg/L indicates that the buffer system in the water is working. This is important from a technological point of view in two ways: first, the reduction of rapid pH fluctuations makes it easier to control in processes such as chlorination/ozonation; second, the strengthening of the carbonate system can increase the tendency for sedimentation in some installations (especially when the hardness is high). Here, however, the sedimentation risk does not appear to be "acute" since the total hardness is low. The fact that pH remains within generally accepted norms on a system scale is also noted in hydro-chemical studies of the Takhtakorpu-Ceyranbatan canal and related facilities: pH and a number of chemical indicators are reported to be within the normative range. This consistency reinforces the logical appearance of the pattern not only "locally", but also within the context of the overall system.

9. Chloride (Cl^-): taste, corrosion, and source effects

Chlorides are among the ions that can affect the taste of water and also increase the risk of corrosion in metal structures. The Cl^- in the sample is 78 mg/L.

10. My analysis results

This value is lower than the limit of 250 mg/L given for WHO and EU in the Jeyranbatan comparison table, and the limit of 350 mg/L given for GOST. It also creates a safety margin of 78 mg/L against the 350 mg/L limit specified for drinking water in the laboratory report (IWRA, 2018). This has two consequences. First, chloride does not appear to be the "first suspect" for complaints about taste and saltiness. Secondly, the role of chloride in terms of corrosion should be assessed in conjunction with other factors (pH, oxygen regime, temperature, total mineralization of the water); here, since the pH is close to the neutral zone and the mineralization is not high, the possibility of chloride exacerbating the corrosion risk seems low. Again, this conclusion does not exclude the possibility that the situation may change in individual parts of the system (for example, in zones without steady flow).

11. General roughness: sediment potential and technological impacts.

Hardness (related to Ca^{2+} and Mg^{2+}) is one of the main indicators that changes the technological "behavior" of water. In the example, hardness is given as 54 mg/L. When this indicator is taken as $CaCO_3$ equivalent, it is approximately 1.08 meg/L and is close to, but lower than, the 1.2 meg/L indicator given for the EU in the Jeyranbatan comparison table. This indicates that the water has a "soft-low hardness" character. Hydrochemical research on the Takhtakorpu-Ceyranbatan canal also shows that the hardness varies in the range of 3.1–4.5 mg-eq/L (depending on the season and location). The sample yield of 1.08 meg/L is below that range, and this may indicate either a "softer water window" for the time and location of collection, or a difference in measurement unit/method (IWRA, 2018). The important point here is that the hardness indicator should not only be used as "below/above the norm", but also as a "mode parameter" for optimizing processing processes. For example, very soft water can in some cases increase the tendency to corrosion; very hard water can increase the risk of sedimentation and rapid clogging of filters. Since the hardness in the sample is low, the source of the sedimentation risk should be sought more in other parameters such as turbidity and suspended solids (World Bank, 2011).

12. Sodium (Na^+) and potassium (K^+): salinity trend and sanitary framework in terms of irrigation

Sodium was measured at 115 mg/L and potassium at 4 mg/L. Since the report provides limits of 200 mg/L for Na and 10 mg/L for K for drinking water, both indicators are within those limits. In terms of irrigation, sodium assessment is more sensitive because the issue here is not concentration alone, but the ratio of sodium to calcium-magnesium (indices such as SAR). Since the available data do not separately provide the Ca^{2+} and Mg^{2+} required for SAR, the "soda effect" of sodium can only be interpreted at a preliminary level. However, given that the laboratory classification specifies a Class I cutoff for Na as ≤180 mg/L, a result of 115 mg/L falls into the low-risk zone. This reduces the likelihood that sodium alone is a limiting factor, especially in normally drained soils. However, from a practical management perspective, this result does not mean "no risk": factors such as the salinization tendency of the soil, the amount of irrigation water, and the salinity of the soil solution must be monitored simultaneously (Pashayev & Hasanov, 2010).

13. Interpretation of results in a normative context and risk mapping

The indicators selected in the sample for the Jeyranbatan canal (pH, Cl^-, Na^+, EC, TDS, dry residue, hardness) are generally consistent with both the drinking water limits given in the report and the regulatory comparison framework for Jeyranbatan. This consistency indicates that the water has a stable and controllable quality background in terms of "major ions". However, the real risks to water quality often lie beyond the "essential ions." The hydro-chemical study conducted on the Takhtakorpu-Ceyranbatan canal and related facilities highlights the fact that biogenic indicators such as ammonium ions may increase in some periods, rivers may take on pollution loads when passing through densely populated areas, and this affects the hydro-chemical regime. This indicates that indicators that are not measured in the current example, but are critical to the system (NH_4^+, NO_2^-, NO_3^-, PO_4^{3-}, BOD_5/COD, microelements and microbiological parameters) must also be included in the program. Another important issue is monitoring frequency. It is noted that in the study conducted on the Jeyranbatan reservoir, more frequent measurements (daily/monthly/quarterly) showed clearer results and that more frequent measurements were appropriate for some parameters (Ganbarov, et al., p.25). This approach is particularly important for channel lines: as the water flow rate and mixing regime change, “peak” events can occur for a short time and then disappear. It is possible to miss this peak in single measurements. Therefore, a risk-based approach seems more workable: for example, operational indicators such as pH, EC and turbidity can be measured more intensively; heavy metals and some trace elements can be measured at longer intervals.

14. Result

Physico-chemical analysis of a sample taken from the Ceyranbatan Canal (part of the Takhtakorpu–Ceyranbatan aqueduct system) shows that the water quality is generally satisfactory according to selected indicators: pH is close to the neutral zone (7.67), electrical conductivity is in the low-medium range (0.66 mS/cm), chloride and sodium concentrations are both within the limits set for drinking water and fall into the low risk zone according to the irrigation water classification. The results do not contradict the hydro-chemical background of the Takhtakorpu-Ceyranbatan channel: against the background of seasonal changes in mineralization and roughness throughout the system, the measured mineralization indicator corresponds to the lower part of the general range. At the same time, assessment limited to “major ions” is not sufficient for sustainable water quality management. Since system studies have shown that some biogenic indicators can increase in certain periods and that anthropogenic impact along the stream affects the hydro-chemical regime, the monitoring program must include nitrogen forms, phosphates, BOD_5/COD, microelements, and microbiological indicators. It is also important to differentiate the measurement frequency by parameter: more frequent monitoring makes the results clearer and allows you to capture risky “peak” events.

References

1. AGROLAB. (2025). *Water sample test report (Report No. Sa-020/25)* [Laboratory report].
2. Ganbarov, E. S., Yagubov, A. I., Gumbatova, R. B., Kurbanova, L. G., & Kasimova, G. M. (2020). Hydrochemical characteristics of water in the Velvelechay–Takhtakorpu channel, Takhtakorpu water reservoir and Takhtakorpu–Jeyranbatan channel, Qusarchay, Qudiyalchay, Cagacuqchay, Velvelechay rivers. *Azerbaijan Chemical Journal*, (3), 17–28.
3. Pashayev, E. P., & Hasanov, F. H. (2010). *History and development of the “Azdovsuteslayiha” Institute* (pp. 4–6).
4. Gidayatzade, S. G. (2022). Analysis of physical and chemical properties of drinking water in the Ceyranbatan Reservoir. *Industrial Chemistry*, 8(5), 200.
5. GOST 2874-82. (1982). *Drinking water. Hygienic requirements and quality control*.
6. World Bank. (2011). *Environmental strategy/environmental review and analysis: Azerbaijan*.
7. International Water Resources Association. (2018). *Azerbaijan: Ceyranbatan ultrafiltration facility*.
8. Japan International Cooperation Agency. (n.d.). *Report on the Shabran–Ceyranbatan (Takhtakorpu) canal within the water supply context*.