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Research Article

ANALYSIS OF THE HYDROGEOLOGICAL CONDITIONS OF THE OBJECT IN ORDER TO CONDUCT AUTOMATED MONITORING OF MEASUREMENTS OF GROUNDWATER PARAMETERS

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ABSTRACT
In this article, the analysis of the hydrogeological conditions of the object for the automated monitoring of groundwater, as well as the introduction of automated measurement systems and data storage in the monitoring wells located in the studied area, the information and technical support of measuring the parameters of groundwater issues of infrastructure development were considered. In addition, the geological structure and hydrogeological conditions of the underground water field were studied in order to install the automated measuring devices of underground water parameters in the observation wells located in the territory of the Kitab-Shahrisabz underground water field.

***Keywords**: monitoring wells, groundwater, automated measuring devices, water level, ultrasonic and radio wave sensors, electrical conductivity, general mineralization, hydrogeological data, Kitab-Shahrisabz underground water deposit, Paleozoic, Paleogene, Neogene and Quaternary deposits*

INTRODUCTION

Presently, a lot of scientific researches on the provision of drinking water to the population are being carried out, in particular such as assessment of underground water resources and their rational use, determination of the laws of water exchange in the regional drinking water field based on automated measurement systems, improvement of automated monitoring methods and the use of high-tech software tools, the methods of creating automated information system. In this regard, it is considered urgent to develop technical solutions based on information systems, automated measurement methods and their algorithms, as well as hardware and software tools in the study of hydrogeological characteristics of underground waters. The world's leading scientific centers conducting scientific research focused on the development of automated methods of groundwater monitoring, including: United States Geological Survey, ESRI Inc., (USA), Geological Survey of Denmark and Greenland, Danish Hydraulic Institute (Denmark), Federal Institute for Geosciences and Natural Resources, German Research Center for Geosciences (Germany), Advanced Industrial Science and Technology (Japan), Chinese Academy of Geological Sciences (China), Schlumberger Water Services, GIS and Geomatics Resources (Canada), Institute of Environmental Engineering System (Poland), Institute of Geology and Mineral Exploration (Greece), Indian Institute of Remote Sensing (India), Geological Survey of the Netherlands- (Netherlands), Korea Institute of Geoscience and Mineral Resources (South Korea), All-Russia Hydrogeology and The Institute of Engineering Geology (Russia), Tashkent University of Information Technologies, and the Institute of Hydrogeology and Engineering Geology (Uzbekistan) are conducting comprehensive scientific research (Djumanov, 2016).
Currently, foreign countries are using automated methods of measuring groundwater regime parameters in practice (Djumanov, 2011).

In the ongoing research work, experimental design work consisting of ultrasonic and radio wave sensors is being carried out to further improve the accuracy level and efficiency of the device for measuring the regime parameters of underground waters (Djumanov *et. al.*, 2022).
It is important to analyze the geological and hydrogeological condition of the area in order to introduce the automated measuring device in the large objects of the national economy.

MATERIALS AND METHODS

For this reason, the geological structure and hydrogeological conditions of the underground water deposit were studied in order to install the automated measuring devices under investigation in the observation wells located in the territory of the Kitab-Shahrisabz underground water deposit.
The geological structure of the Kitab-Shahrisabz underground water field includes geological deposits from the Paleozoic era to the present (Diyarov Ch.D. et al., 1991).
The Kitab-Shahrisabz groundwater deposit belongs to the II-order Bukhara-Karshi artesian basin and the I-order Amudarya basin.
In the hydrogeological section of the studied area, there are aquifers of the Paleozoic Paleogene, Neogene and Quaternary deposits, as well as Eocene impermeable layers.
Aqueous and impermeable layers of the Poleogen lie at a considerable depth in the research area. The salt content of the water in these deposits is high and does not depend on the water supply due to its low water content.
Water in Quaternary, Neogene and Paleozoic deposits is of practical importance for water supply. The surface part of these deposits on the mountain slopes and foothills plays the main role in the formation of underground water in the natural process.
The current period is an underground water complex in alluvial deposits. It is widespread in the Kashkadarya River and its tributaries, and in the first and second stages of the river.
Gravel, sand, and sandy soils are the water-retaining layer, lying in the form of a lens, and one often replaces the other.
Alluvial deposits are waterless in the pre-mountain part of the cone-shaped deposits, and in the middle part of the cone-spread, underground water comes to the surface in the form of a spring and flows into the riverbeds. The amount of water coming out of the springs is 0.5-2.0 l/s, and after 300-400 m it is absorbed from the alluvial deposits and comes to the surface of the earth. The amount of salts (mineralization) in these waters is 0.2-0.75 g/l, and it is of the bicarbonate-sulfate calcium type. The water in the alluvial deposits in the part of the riverbed where the neogene layers are crossed is of the hydrocarbonate-sulphate magnesium type, with a salt content of 0.8-1.2 g/l.
Groundwater is produced by surface runoff and seepage from irrigated lands.
Forming the flow of subsurface water in the alluvial bed, it moves in the direction of the beds, and most of this flow exits in the hollow area.
Water complex in alluvial-proluvial deposits of the Middle Quaternary period.
This complex research field has been studied extensively. These complex deposits are distributed everywhere in the depression area. The water-retaining rocks consist of lyoss-like supes, gravel with layers of clay and large stones. They are covered by Quaternary gravels from above and form a single aquifer. Pliocene siltstone, small amounts of conglomerate and sandstone lie below. The thickness of the described complex is 300 m in the center of the depression and decreases towards the western and mountain sides. Here, the thickness of gravel and large stones decreases proportionally, and the thickness of loess rocks increases (Muhammadiev K.U., 2020).
The prolluvial layer of the Middle Quaternary period has little water. When the amount of water taken from wells is 0.05-0.25 l/s, its level decreases by 0.5-0.7 m.
Groundwater distributed in gravel and lyoss like rocks is fresh. The total amount of dissolved salts is 0.3-0.85 g/l, and depending on the composition, it is bicarbonate-calcium and bicarbonate-sulfate-calcium.

Groundwater in the described complex is formed and saturated from seepage and absorption of rainfall from lands irrigated by rivers, streams, and canals, as well as from underground waters coming from the mountain side. A part of the stream flows out of the studied area to the west.

Aquifers in Neogene deposits.

Kitab-Shahrisabz concavity is scattered everywhere. In the research area, they lie under thick Quaternary deposits.

Groundwater is distributed in layers of gravilite, conglomerate and sandstone and is located between layers of clay and sandy clay. Depending on their location, they are interlayer water and are pressurized. The total thickness of the complex is up to 900 meters.

In the middle part of the depression, the pressure of the complex of Neogene waters is high and reaches 500 m, and the piezometric level is 1.5-2.5 m below the surface of the earth. The Neogene water complex is an average aqueous (hydraulic) complex and the amount of salts in the water ranges from 0.4 g/l to 4.0 g/l.

Due to the high pressure, the waters of the Neogene complex are poured into the high-water complexes in places where there are no waterproof layers.

Groundwater in cracks of Paleozoic deposits.

In the northern part of the study area, it is widely distributed in the intrusive sour and basic composition granitoids and tectonic cracks of the Karatepa mountain. In general, there are not many cracks in the mentioned rocks, the amount of water coming out of the springs does not exceed 0.1-0.5 l/s. Only the amount of springs coming out of the cracks at the contact of two rock beds reaches 2-3 l/s.

Paleozoic sedimentary rocks have significant lithological and tectonic cracks. The amount of spring water coming out of these cracks is 50-150 l/s. Paleozoic water is fresh, the amount of salts is 0.1-0.8 g/l, the composition is hydro carbonate-potassium.

The water in the rift zone of the Paleozoic is formed and saturated by the absorption of precipitation in the part of the sediments of this period that has reached the surface of the earth, as well as by the seepage of the surface water that has crossed the tectonic cracks, that is, the water in the streams.

It was concluded from the above. Middle Quaternary and Neogene reservoirs are of great importance in providing underground water for irrigation of Kitab, Shahrisabz and Yakkabog districts of Kashkadarya region. It is advisable to carry out hydrogeological research works mainly in these deposits.

The set of physical, chemical and biological indicators that can be used to describe the hydrogeological properties of groundwater is divided into the following groups (Khushvaktov *et. al.*, 2019):

- hydro regime characteristics - water level, water level slope, water volume, etc.;
- characteristics of the underground water temperature regime - water temperature change, amplitude, heat flow, etc.;
- characteristics of the hydro chemical regime - water mineralization (salinity), salt content (content of individual salt ions), concentration of organic, biogenic, polluting substances, etc.

Based on the above, it is possible to determine the general level of mineralization of groundwater, ionic strength, hardness, as well as the content of sulfate ions in groundwater by the value of electrical conductivity (Nazirova, 2022).

In continuous, long-term, continuous, real-time monitoring of water level, a hydrostatic pressure sensor (also called a hydrostatic level gauge) used in determining the water level is the main technology and measurement principle of the sensor.

Hydrogeological studies are an important part of human scientific and economic activity. They are carried out as separate works or together with engineering-geological studies. For example, in the design of any structure, it is important to study the characteristics of the soil, the degree of occurrence of groundwater, their volume and the direction of underground flows. Hydrogeological studies help to equip deep wells for water extraction. Information about underground water reserves, their relationship with rocks and soils, as well as water properties (porosity, moisture capacity, capillarity, etc.) is of great importance in water supply, hydraulic engineering, road and general construction. is important.

Groundwater level measurement is critical for predicting long-term trends in water table decline, saltwater intrusion, seasonal changes, aquifer recharge, surface aquifer conservation and restoration, and drinking water status.
The researched automated measurement methods also help to solve the following issues:
conducting complex hydrogeological studies and observations during experimental filtration works;
carrying out regular monitoring of the condition of the subsoil during development of cluster pumps, extraction wells;
conducting hydrogeological work in remote and hard-to-reach areas;
measuring the temperature of underground water at a certain depth in research, monitoring, mode wells, piezometers of production wells;
monitoring water flows at measuring stations;
hydrodynamic monitoring of seismic risk;
monitoring the effectiveness of drainage measures in mineral deposits;
balanced management of drinking water resources;
monitoring of aquifers;
warning about the possibility of natural disasters and floods.
The device under study reliably measures the required parameters due to its long and durable battery life.
Based on the information and technical support of conducting hydrosphere monitoring on observation wells, it is important to replace the laborious measurement process by manual labor with automated sensors in the collection of observation data at hydrogeological stations in our republic.

RESULTS AND DISCUSSION

The hydrogeological conditions of the research area mentioned above were studied. As a result, the information and technical support infrastructure for measuring groundwater regime parameters was developed for the introduction of automated monitoring methods in the territory of the research object (Fig. 1).

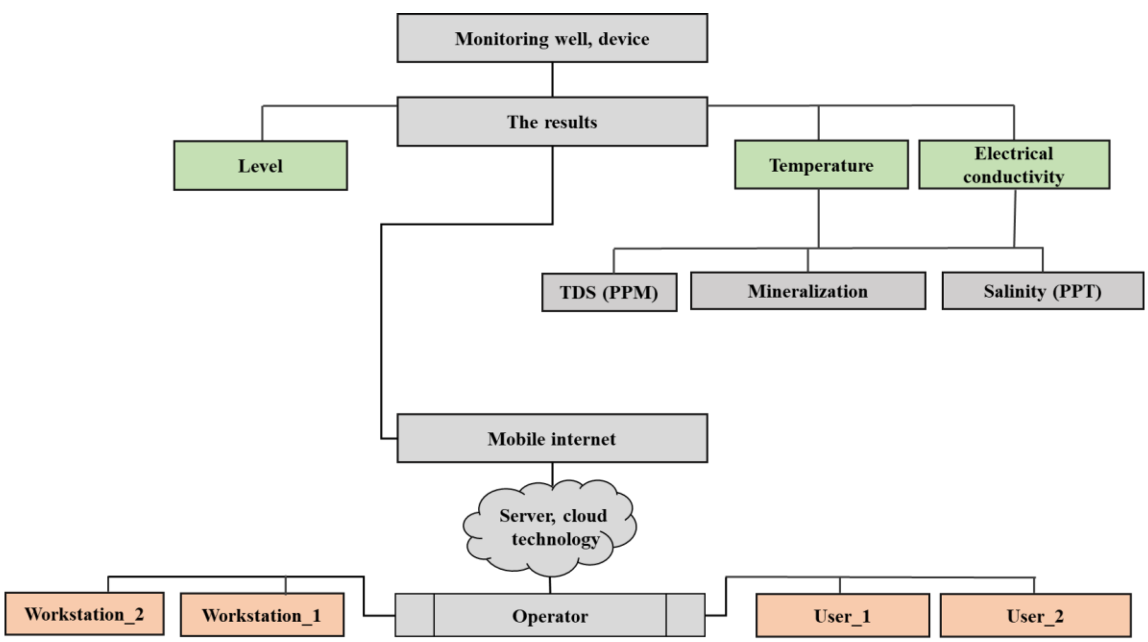

Figure 1. The infrastructure of information and technical support for measuring the parameters of the hydro regime of underground waters.

Various measurement methods (continuous measurement, averaging and testing) can be used during monitoring, mode and test filtering works to increase information content and obtain accurate and objective data.
The information system and software complex are divided into regions according to different climatic conditions, according to the level of humidity - zones, according to the level of contamination and drainage - plots, according to the characteristics of geological and hydrogeological conditions - regions, geomorphological conditions according to - areas, according to the thickness of the aeration zone - such as regions and thereby determines the direction of research on the study of the regime and balance of groundwater.

A software complex has been created to help install this device in monitoring wells, which consists of menus such as settings, data retrieval from memory and setting the data transfer interval, as well as taking measurements (Figure 2).

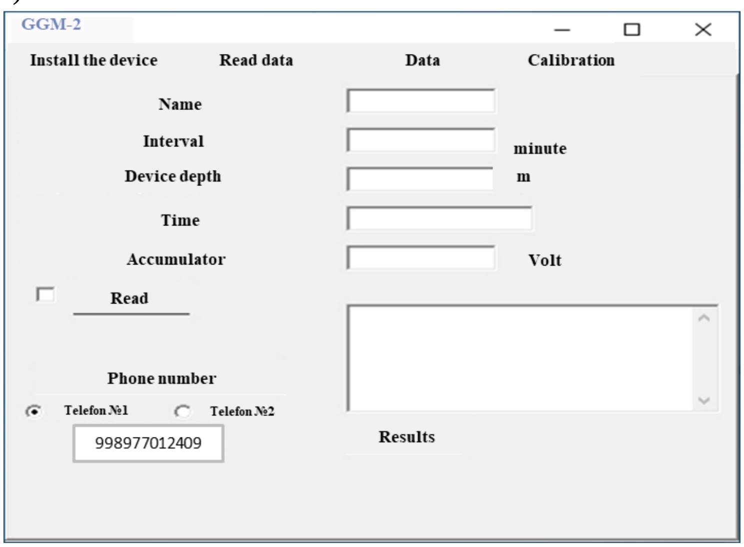

Figure 2. Interface of the software complex that helps to install the automated measurement device in the monitoring wells.

It is vital to use the modern information communication systems, i.e. a general device-software complex in hydrogeological and engineering geological studies conducted with the purpose to reveal the elements and balance of the hydrogeological regime in the process of observational monitoring of groundwater and in solving various issues of the national economy (Djumanov *et. al.*, 2022).
Stationary hydrogeological observations for the purpose of studying the elements and balance of the underground water regime allow to give a qualitative and quantitative description of the processes of formation of underground waters, to determine the main laws of spatial and temporal changes of their quantity, quality and properties. it is necessary to justify the development, development and protection of the most reasonable measures in the use of water, the composition of projects to fight against their harmful effects, and the methods of managing their monitoring regime.
The study of the underground water regime makes it possible to determine the following:
1) connections necessary for predicting natural or disturbed regimes and dependence of regime elements on natural and artificial factors (or their combination);
2) separate elements of the water balance used in the justification of water management activities, hydrogeological characteristics and water balance calculations;

3) the nature and degree of impact of human engineering activities on groundwater and the events and processes associated with changing their regime (substantiation of the most rational methods of groundwater regime management, their economic use and protection).

Method of hydrodynamic analysis of groundwater regime. It is carried out on the basis of applying the theory of unstable movement of groundwater in the calculation of the main elements of their balance and observing the regime of groundwater. The method takes into account the hydrogeological situation in all respects, allows to estimate the infiltration of precipitation, the reach of irrigation water to the groundwater level, the consumption of total evaporation and underground flow, as well as the necessary hydrogeological indicators. All this information is directly used in the preparation of forecasts of changes in the groundwater regime under the influence of human socio-economic activities. The method is particularly effective and cost-effective in the practice of hydrogeological research, because the main source of observation data on the water level regime is obtained from special observation wells located in typical balance zones (flow elements).

Conclusion

The analysis of the hydrogeological conditions of the object is important for the automated monitoring of underground water. Because the geological structure of the research area, hydrogeological condition, interaction of underground water layers, infiltration processes, irrigation water reaching the groundwater level, consumption for general evaporation and underground flow, as well as the necessary hydrogeological survey determination of the necessary observation wells that allow to evaluate indicators and measurement of regime data based on the automated measuring devices placed in them are carried out. Peculiarities of underground water monitoring and information and technical support: online control of groundwater level, general mineralization, environmental conditions, continuous measurements, reduction of the number of national regime measurements, reliability of information, provide opportunities such as increasing the efficiency and productivity of ongoing hydrogeological works, saving financial costs, and measuring permanent hydrologic features in real time based on a network of wireless sensors. In addition, the automated measuring device is used to create a distribution map of the groundwater level, to make quick decisions on planning and implementation of the water use procedure, to use it in the calculation of the main elements of their balance, to monitor the groundwater regime, and also allows to evaluate the necessary hydrogeological indicators.

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