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The Use Of Water Resources In The Akhangaran Basin In The Almalyk-Akhangaran Industrial Region

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ABSTRACT: This article describes the state of groundwater and surface waters in the Akhangaran River basin, around the Almalyk Mining and Metallurgical Complex (AMMC), the amount of water consumed by the population of the city of Almalyk, the amount of precipitation in the region, and the annual flow regime of existing canals in the region. Comprehensive research methods, include the analysis of scientific and technical information on the geographical, hydrogeological, geomechanical and mineralogical compositions of the Almalyk industrial region, underground and surface waters, as well as the study of all valuable components by chemical, and X-ray structural methods, and atomic emission spectroscopy. Integration and point methods are used for measuring current velocity. Basic, detailed, abbreviated and graphical methods for measuring water flow are perfomed by electric metrs. Experimental filtration studies are carried out and systems of observation wells are organized. Additionally water temperature is measured with thermocouples and water density, salt concentration, and water pH are measured using ionomers.

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KEY WORDS: Groundwater and surface water, Almalyk Mining and Metallurgical Complex (AMMC), air temperature, groundwater level, measurement, average annual flow

INTRODUCTION

The existence of all living organisms on Earth is associated with water, which is an important and unique substance mineral involved in the regulation of all processes in the body. There is no other mineral in nature that can replace water for human life. Water is an important factor in almost all processes occurring in the geographic crust, wich is why water is the most important resource on Earth [19; 6; 1; 11: 28].

The rapid growth of the world's population, the development of industry, the increase in the number of large megacities and the use of fresh water in irrigationed for agriculture, among other, factors have led to an increase in the demand for water, especially in arid climate zones.

Groundwater plays an important role in providing the population with water. In ancient times, our ancestors did not use groundwater for irrigationed of agriculture. To save water resources, wells were used as sources of drinking and watering livestock [16; 12; 3; 9: 29].

According to the data of the Republican Hydro-Information Center, groundwater reserves with mineralization of less than 1 g/l have decreased by 40% over the past 30 years (1980-2010). In recent years, the use of groundwater for irrigation, and municipal and technical purposes has expanded. As a result, the composition of groundwater has deteriorateds, making it unsuitable for use as drinking water [20; 25; 13; 17; 2; 18].

In connection with the construction of the Almalyk Mining and Metallurgical Complex (AMMC), the surface and underground waters of the Akhangaran River basin are used to provide water for technological and household processes. The underground waters of the Angren basin are the main water source for the AMMC and the city of Almalyk. In this regard, it is relevant to study some of the geographic patterns of surface water, and groundwater and water quality in the Akhangaran River basin [22; 26: 30].

This study evaluates the surface and ground-waters of the Akhangaran River basin. The Akhangaran River is located between the Chatkal ridge and Kuramin ridge, with a height -of 2710 m, and coordinates of 41°17′55″ and 70°37'13″, It has a length -of 236 km, a basin area -of 7710 km², and a water consumption -of 22.8 m³/s, (by Turk village).

MATERIAL AND METHODS:

Comprehensive research methods, include the analysis of scientific and technical information on the geographical, hydrogeological, geomechanical and mineralogical compositions of the Almalyk industrial region, and underground and surface waters, as well as the study of all valuable components by chemical, X-ray structural methods, and atomic emission spectroscopy. Integration and point methods were used for measuring current velocity. Basic, detailed, abbreviated and graphical methods for measuring water flow by electric metres were employed. Experimental filtration studies were carried out and systems of observation wells were organized. Additionally, water temperature was measured with thermocouples and water density, salt concentration, and water pH were measured using ionomers [5; 15].

RESULTS AND DISCUSSION

The joint-stock company AMMC is one of the largest industrial enterprises in the Republic of - _Uzbekistan, in addition, it is focused on the production of exported products. The ore is mined in an open pit, and then these ores are, crushed and enriched by the flotation method. The grinding process is carried out in an aqueous solution. Then, the pulp is subjected to enrichment, which flows completely in an aqueous medium. On average, more than 35 million tonnes of ore per year are processed by flotation in concentration plants, and the hourly water consumption is -21,000 m^3/s [14; 26].

The Almalyk-Akhangaran industrial region has a rich mineral resource base, but is poor in water resources.

Water resources in the industrial area are represented by surface and underground flows of the Akhangaran River and its tributaries. There are no glaciers in the Akhangaran River basin, therefore, river runoff, the main factor in the formation of groundwater, largely depends on the annual water content. The recurrence rate of dry years is (P> 50%) - 4 -5 in 10 years.

The underground waters forming in the Akhangaran River basin are of to the infiltration genetic type. According to their conditions of occurrences, ground, pore and fractured-pore waters are distinguished.

In the intermontane valley of the Akhangaran River, one of the largest underground water deposits is developed, and is confined to the modern alluvial deposits of the Syrdarya Complex and permeable pebbles of the upper Anthropogenic age. The deposits of the productive aquifer are characterized by high filtration properties, good water availability and a close connection with the river.

Groundwater deposits are formed in the section of the valley from the village of Turk to the Syrdarya River. The thickness of the aquifers varies down the valley from 10 to 120 m.

Groundwater is fed by the infiltration of surface runoff and side inflow. It is are consumed by wedging out and evaporation.

The valley between the Karakhtay and Saganak sections, it was approved by the State Commission for Reserves of the Republic of Uzbekistan in categories A + B + C yield-10.424 m^3/s of operational reserves, including industrial categories A + B, which yield -7.724 m^3/s [10].

The distribution of reserves by settlement blocks is shown in Table №1. These reserves are used by 13 groundwater and 54 single water intakes. All water intakes on a territorial basis are combined into 3 water intake complexes: Almalyk, Saganak and Akhangaran.

Table № 1. Stocks and flow rates of groundwater by water intake complexes.

№	Water intake complex	Calculation block and water intake	Approved reserves of the category, quantity in m^3/s.	Actual water yield by years, given in m^3/s.		
				2017	2018	2020
1	Karakhtai-Akchin;	a) Karakhtai water intake, well № 13k, 14k, 15k, and 24k. b) Karakhtai coastal and 27k.	A+B 2,744	0,304	0,440	1,072
2	Sartamgali;	a) Sartamgali b) Karakhtai (except for 13k. 14k. 15k. 24k.) c) Single water intakes 18r, 134 RUR 2de, and 25k.	A 1,76	2,251	2,311	2,136
3	Tash-Almalyk;	a) Tash (industrial-drinking). b) Tash-Sartamgali c) Single No. 37c, 37b, 37r, 38a, 38r, Bytkhim 1,2,3,4; 44e, 45a, 45 e, Shirabad karst sinkhole.	A+B 1,92	2,181	1,996	1,833
4	Akhangaran (right bank)	a) Akhangaran b) Upper-Akhangaran c) Lower-Akhangaran d) Single №. 56r. "Zagotstock" "cleaning" 1,2,11e, 12e, 13e,	B 1,3	0,528	0,598	0,676
5	Lower (Toytepi)	a) Zakonturny b) Saganak c) Ivalek d) Lower-Saganak e) Single; "Sawpitomnik", "Kerauchi", the village of Kultepa, the village of Koriz, the village of Kulota, Kirkkizota, "Cleaning".	C 2,7	2,231	2,115	2,27
6	Total for the industrial area;		A+B+C 10,424	7,495	7,460	7,986
7	Including;		A+B 7,724	5,264	5,345	5,716

The Almalyk water intake complex (AWC) includes group and single water intakes located in the left-bank section of the Akhangaran River valley, between the Karakhtay and Almalyk exploration sections. These are the Karakhtai areal and coastal, Sartamgali, Tash-Sartamgali, and Tash industrial and drinking water intakes called "heap leaching", and a number of single water intakes.

The Saganak water intake complex (SWC) includes group and single water intakes located on the left-bank section of the valley (from the Almalyk exploration site to Tashkanal). These include: the Fabrichny, Zavodskoy, Zakonturny, Saganak, Lower-Saganak, and Ivalek group water intakes and a number of single borehole water intakes.

The Akhangaran water intake complex (AkhVK) includes all water intakes located on the right-bank section of the valley. These are the Akhangaran, Upper-Akhangaran, Lower-Akhangaran and single borehole water intakes. The water intakes of the AWC interact with each other, while the water intakes of the SWC and AkhWC do not interact. The AWC and SWC supply water to the Almalyk industrial centre, AkhWC - Akhangaran.

We measured the level and temperature of groundwater in observation wells and the level in production wells. Measurements of flow rates were made in production wells when working on the outflow, where possible according to technical conditions. A total of 16 measurements were made, of which 12 were measured at the Karakhtai water intake. The data obtained are shown in Table №2. Measurements of the groundwater level in observation wells with depths of 0-20 m and 20-40 m were made using rods at gauging stations.

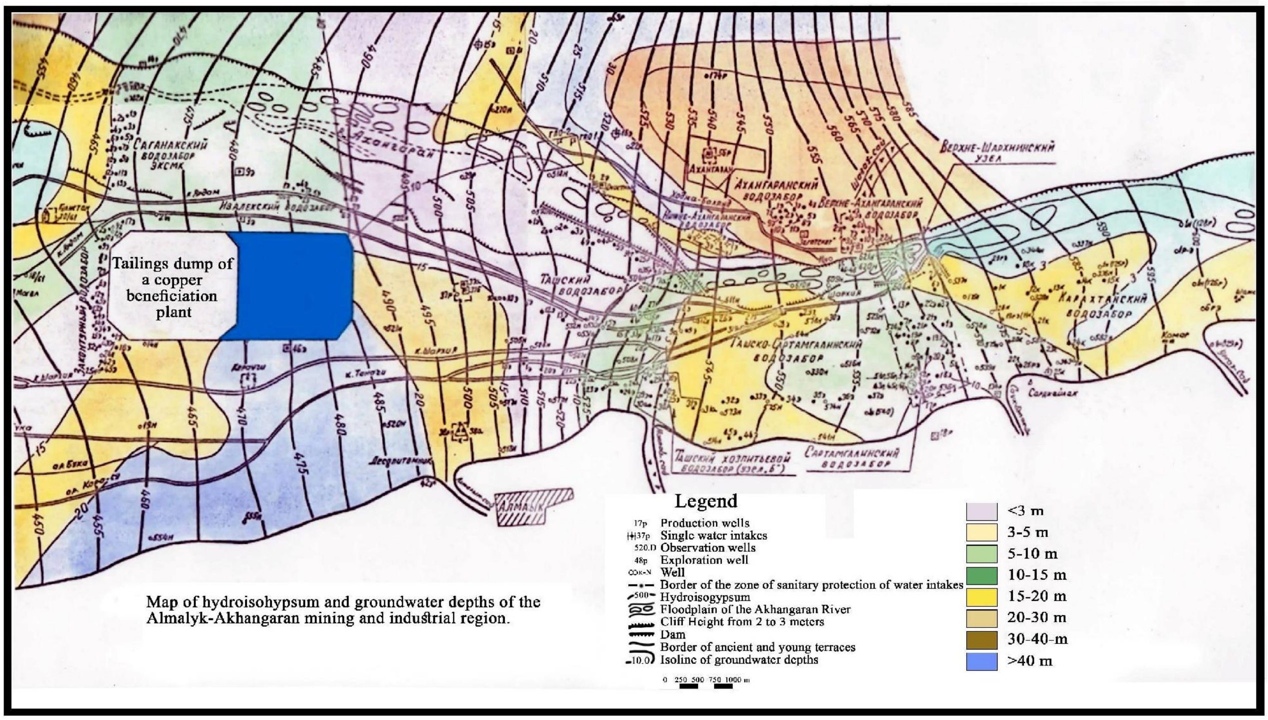
The climatic features of the region are also factors that affect the groundwater regime. In 2020, from January to May, the annual precipitation rate increased several times. The annual amount of precipitation for 2019, according to the Angren meteorological station, which is located at an altitude of -942 metres above sea level, was 580,3 mm, which is 115,8% of the average long-term norm (495,8 mm). The amount of precipitation from October 2019 to March 2020 in the Akhangaran River basin was 435 mm, i.e, 124,8% of the norm. Relatively higher snowmelt in the lower zones is because the air temperature in March in the Kuramyn and Chatkal ridges was 3-5°C higher than the norm. According to our measurements and research, the air temperature is characterized by the following indicators: the average annual temperature is 17,5°C with a norm of 16,9°C (in 2018-2019, the air temperature in the summer reached 46°C), the coldest temperatures was occurred in February 2018 and 2019, during which the average monthly temperatures were 2,6-3,5°C, with a norm of 1,6°C, and the hottest temperatures occurred in July and August (until August 20), and the average monthly air temperature was 31,5°C with a norm of 26,1°C 2019). The average annual relative air humidity was -54%, the highest air humidity was observed in November at 76%, and the lowest was observed in July at -29% [7; 8; 24; 4].

Table № 2. Measurements and sampling in observation and production wells in the Almalyk region (2019).

№	Work completed	Unit of measurement	Measurement quantity	Note
1.	Measurement of the groundwater level in observation wells 0-20 metres deep,	Measurement, quantity	60-70	
2.	20-30 metres deep,	Measurement, quantity	75	
3.	Measurement of the level and temperature of groundwater in observation wells 0-20 meters deep.	Measurement, quantity and temperature + 17.18 ° C	250	Measurement by water metre and counter.
4.	Also 20-40 meters deep.	Measurement, quantity	7	
5.	Measurement of the water level in production wells.	Measurement, quantity	1250	Travel only on foot.
6.	Water sampled from wells for reduced analysis.	Sample, litres	2	
7.	Water samples collected from the well for full analysis.	Sample, litres	12	
8.	Measurement of the water level along the rail.	Measurement, quantity	2	Field work.
9.	Experimental work to determine the geofiltration parameters.	litres	12	

We studied mainly the Akhangaran basin. The average annual flow through the Sartamgalinsky hydroelectric station (the city of Almalyk is fed from this flow) is within 20m³/s, and its availability is 92-93%.

Regulation of the Akhangaran River flow (picture) by the Akhangaran reservoir in 2018 took place in March-August. The accumulation of the reservoir took place in March-May, and the damage to river runoff was 22,5-70%. The increase in river flow during this period was 189,4-410%.



Picture: Map of – potentiometric surface **and groundwater depths of the Almalyk-Akhangaran mining and industrial region.**

As shown in the map of the potentiometric surface of the Almalyk-Akhangaran mining and industrial region, the increase or decrease in groundwater depends on the mode of operation of the canals that pass through the mining region. There are 5 channels that have been studied and researched in detail throughout the year (2018-2019).

1. Canal Sharhiya (c 1) was studied during the year, the average annual flow rate in the canal is was 9,2 m³/s, the average growing season is was 12,4 m³/s, and the average value for the non-growing period is was 6,1 m³/s;

2. The concrete Canal Yardam (c 2) was closed in January, February, November, and December. The average annual discharge was 1,1 m³/s, the average in the growing season was 2,1 m³/s, and the average in the non-growing period was 0,022 m³/s.

3. The concrete canal Tanachi-Buka (c 3), was characterized by an average annual flow rate of 2,63 m³/s, the average flow rate in the growing season was 4,22 m³/s, the average in the non-growing season was -0,11 m³/s, and channel (c 3) did not work in January-February and December.

4. The Yardam canal (small) (c 4) had runoff in March-August and October, and the average annual discharge was -1,2 m³/s, in the nongrowing period it was 0,62 m³/s, and the average vegetation discharge was 1,82 m³/s.

5. The Khadzha-Balyand canal (c 5) (upper canal from the side of the Akhangaran water intake) (picture) had water throughout the year. The average

annual flow rate was 2,1 m^3/s, the average monthly flow rate was 0,44 m^3/s, the average flow rate in the growing season was 3.9 m^3/s, and that in the non-growing season was no more than 0,8 m^3/s Thus, the impact of water management on surface runoff was estimated based on the result of the balanced hydrometry of the studied period (mainly 2018-2019).

The balanced income in the studied region is made up of the costs made by the channels, in 5 channels (c 1, c 2, c 3, c 4, and c 5), two canals are concrete and 3 are natural ground. These include Yardam, Tanachi-Buka and the irrigation network along the Sartamgali hydraulic well (picture). The balanced expenses items are made up of the costs of the indicated canals, their outward branches, and the Karasu River along the Tash hydraulic well.

The average annual water losses in 2018 in the region were -1,42 m^3/s, the average for the growing season was -2,52 m^3/s, and the average for the non-growing season was -0,47 m^3/s. The maximum monthly average loss of -3,1 m^3/s, occurred in June, and the minimum of -0,042 m^3/s occurred in January.

Thus, it can be concluded that the years in which the canals were studied (2018-2019) had high water availability. The supply of the average annual surface runoff in the Almalyk-Akhangaran industrial region was 104.2%, and the supply of the total flood runoff (March-June) was 101,2%. Industrial and drinking water supply in the industrial region is provided at the expense of the underground waters of the Akhangaran River valley. The productive aquifer is confined to the alluvial pebbles of the Syrdarya and Golodnostepi Complexes [23; 21].

According to our data, the actual water consumption of the AMMC for production needs is -2,72 m^3/s, and that for the agricultural needs of the plant is -1,3 m^3/s. For the needs of various organizations of the Joint-Stock Company of the Almalyk Mining and Metallurgical Complex, -2,2 m^3/s of water is used, for household and drinking water supply of the city -2,1 m^3/s is used, for agricultural irrigation and water supply -0,85 m^3/s is used.

The Almalyk enterprise "Suvokova" receives -1,1 m^3/s of water from the AMMC during the period of peak water consumption (0,56 m^3/s comes from the Karakhtai areal water intake -). The actual water consumption of the city of Almalyk during the peak period, taking into account the water transferred by the AMMC for household and drinking needs, is 3,2 m^3/s, of which 2,89 m^3/s is used for the household and drinking needs of the city, and 0,66 m^3/s –is used for the household needs of various organizations [27].

CONCLUSIONS.

It is necessary to establish a strict accounting of the amount of water used for household, drinking and industrial needs. Such accounting is possible with the help of multiday or continuous self-feeding devices installed on water conduits. In industrial areas, it is necessary to continue studying the groundwater regimes, the chemical and mineralogical composition of water, and soils, and the operation of water and intakes to develop recommendations for integrated and rational use, as well as the protection of water resources from depletion and pollution.

To obtain high-quality information during research, it is necessary to equip all production wells with flow metres and measuring pipes at each water intake. In addition, it is necessary to equip recorders and devices for work during pumping -to restore the outflow to measure the performance by a the hydrometric method. As a result, it becomes possible to clarify the productivity of wells and the geofiltration parameters of the aquifer.

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