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On The Technogenic Impact Of Industrial Enterprises Of The Almalyk Region On The Ecological And Hydrogeological Conditions Of The Akhangaran River Valley

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ABSTRACT

The article deals with the issues of technogenic (anthropogenic) impact of industrial enterprises, quarries and agricultural land of the Almalyk region on the environment.

As a result of the infiltration of polluted water from waste dumps, slag and tailing dumps of factories, as well as irrigated lands, the penetration of polluting components into the groundwater occurs. The lithological protection of groundwater from the penetration of polluted waters in territories with different geological and geomorphological conditions is considered.

KEYWORDS

Groundwater, hydrogeological conditions, pollutants, sources of pollution, lithological protection of groundwater, filtration properties of soils, groundwater deposits.

INTRODUCTION

As you know, the flow of pollutants into groundwater depends on the natural protection of the latter. The protection of groundwater from pollution is understood as the "overlap" of the aquifer with low-permeable sediments and the hydrodynamic conditions of the aquifer, which prevent the spread of pollutants along the flow of groundwater (1).

The assessment of the lithological protection of groundwater was carried out on the basis of the collection and analysis of the results of past

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years of research, especially complex hydrogeological and engineering-geological surveys of irrigated areas (2, 3, 6).

According to the lithological protection of underground waters from the penetration of pollutants into them, areas with different geological, geomorphological and hydrogeological conditions characterizing the unity of such protection criteria as the depth of groundwater, lithological composition and thickness of low-permeable sediments, as well as their filtration properties are distinguished.

SYSTEM OF VALUES

According to the degree of lithological protection, areas with unprotected, low, weak and medium protection are identified. The unprotected areas correspond to alluvial plains, including floodplains and lower terraces of rivers and alluvial cones, where groundwater levels occur at depths of 0-3.0 m, and the filtration properties of the cover sediments are characterized by filtration coefficient values of 0,5-1,0 m/day and more. The time it takes for pollutants to reach the groundwater level is 5-7 days.

Areas of low protection include areas of flat alluvial-proluvial and alluvial plains confined to the side parts and valleys of the Akhangaran River and interfluvial massifs. The depth of the groundwater level increases to 3-4 m, the filtration properties of the cover deposits decrease to values of the coefficient of 0,1-0,4 m/day.

Hilly and undulating alluvial-proluvial plains developed in interfluvial massifs correspond to areas with poor protection of groundwater. The aeration zone is composed of loess-like loams with a filtration coefficient of 0,4-0,5 m/day. The groundwater levels here lie at depths of 5-10 m and more, and the filtration coefficients of sediments in the aeration zone are 0,1-0,5 m/day or less.

Areas with medium protection include areas of the right-bank part of the Akhangaran MPV. The aeration zone is composed of loess-like loams, sandy loams with a filtration coefficient of 0,1-0,4 m/day. Groundwater occurs at a depth of 15-20 m and more.

The highest migration rate of pollutants in the underground flow is recorded in the area of the floodplain and the valley of the Akhangaran River, which is confirmed by the size of the halo of substandard waters in this area.

In the presence of clay layers in a relatively homogeneous section of pebbles, a decrease in the concentration of pollutants from top to bottom and their accumulation in clay rocks are observed. This is due to the fact that the mineralogical composition of loamy sediments contains a significant amount of clay fractions (30-35% of the total volume), which, due to the sorption characteristics and their structure, contribute to an increase in sorption and, as a consequence, slow down the migration process.

The ecological and hydrogeological conditions of the geological environment of the study area were assessed by the implementation of a set of field, laboratory and office work.

The development of industry and agriculture within the Almalyk region caused anthropogenic metamorphization of the qualitative composition of both surface and groundwater interconnected with them. Within the Akhangaran river valley alone, there are more than 20 industrial, communal and household and other enterprises, which are concentrated mainly in the cities of Akhangaran, Almalyk and adjacent territories (Fig. 1, 2).

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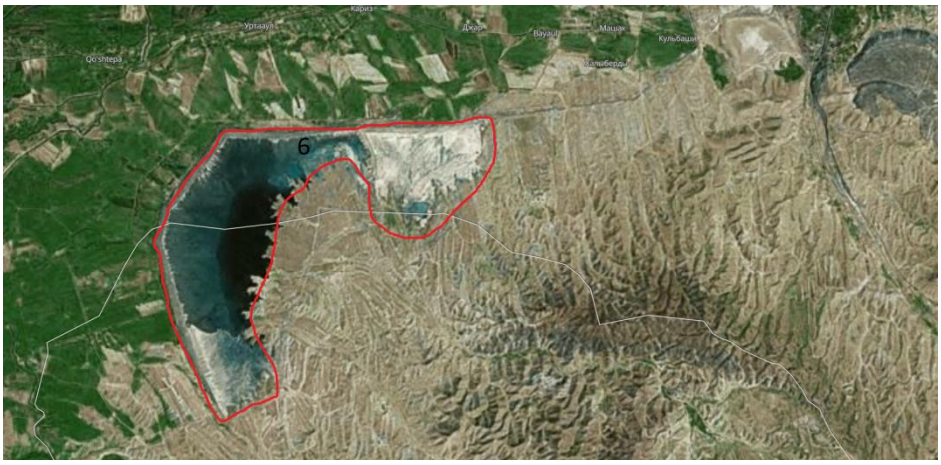

Fig. 1 Satellite image of the tailing dump of the copper-processing plant AMMS.

Figure. 2 Aerial view of the Almalyk copper smelting plant AMMS (3-waste and slags of the Almalyk chemical plant, 4-slag accumulator of the copper smelting plant).

METHODOLOGY

Depending on geological, hydrogeological and climatic factors in natural conditions, on the one hand, and anthropogenic load, on the other hand, the following are distinguished in the area of work:

1) A favorable ecological state, an admissible level of groundwater occurrence (> 10 m) or potentially hazardous, groundwaters of the right-bank part of the Akhangaran MPV are protected to a weak and medium degree. Mineralization and general hardness, the content of microcomponents and other specific elements does not exceed the maximum permissible concentration (MPC) for industrial and drinking water (GOST 950-2011 [5]);
2) An unfavorable ecological state, a dangerous level of pollution by substandard waters associated with the

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general salinity and hardness of waters, exceed the maximum permissible concentration (MPC) in 2-3 times, both in natural conditions and in conditions subject to technogenic influence; the concentration of chemical elements in water is higher than the maximum permissible concentration (MPC); groundwater is not protected or its protection is very low.

In the areas below the industrial sites of the AMMC (Almalyk Mining and Metallurgical Combine) and AChP (Almalyk Chemical Plant), groundwater salinity is 0,8 – 1,0 g/l and depends on the mode of operation of the pollution source, the season of the year and other factors (Fig. 3).

Fig. 3 Satellite image of the settling basin of the copper-processing plant AMMS.

Ground waters with dense residues exceeding 1 g/l are confined to the left edge of the Nakpaysay river valley up to the Tashkanal site. Local contaminated areas are noted below the tailing dump of the copper-concentrating plant (MOP). Here, in groundwater, the Mn content occasionally exceeds the maximum permissible concentration (MPC). Among other pollutants, Mo, Cu, Pb, Zn were recorded in concentrations up to 0,5 maximum permissible concentration (MPC).

There is widespread areal pollution of groundwater in the middle part of the Akhangaran river valley. Consequently, the lower part of the valley in the ecological respect is characterized by a moderately satisfactory condition and has a tendency to change the quality of groundwater towards deterioration. In addition, in the lower part of the valley, there are areas with underground waters of unsatisfactory natural conditions (water salinity more than 1,5 g/l).

Within the middle reaches of the Akhangaran River (Pskent groundwater deposit), due to the development of irrigated agriculture, loess-like loams are completely water-saturated during the year, and with the termination of the irrigation season, the water saturation of loams is somewhat reduced. Therefore, the aquifer enclosed in loam has a locally aquiferous character; salinity of water, in general, is more than 1,5 g/l; ecologically, the water quality is unsatisfactory.

Mn, Cd, Sr, the concentration of which is higher than the maximum permissible concentration

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(MPC), were found in underground waters near the combined tailing dump (OXH) of the Almalyk mining and metallurgical plant.

Mineralization of groundwater decreases with depth. So, in the central and southwestern parts of the Pskent groundwater deposit at a depth of 3 m, the dry residue is about 1,5 g/l, water hardness is 15 mg-eq/l, and at a depth below 50-60 m mineralization does not exceed 0,5-0,7 g/l with a total hardness of 6,5-8,6 meq/l.

On the territory of the Dalverzin groundwater deposit, groundwater of a moderately satisfactory condition is widespread. Areal pollution with nitrogenous compounds (0,5-1 MPC) is observed throughout the entire territory of the field, and in some local areas, the content of oil products and nitrates exceeding the maximum permissible concentration (MPC) is recorded.

RESULTS OF STUDIES

In general, the following can be noted for all groundwater deposits in the study area:

a) Mainly the upper part of the aquifers, the thickness of which ranges from 5-10 to 40-50 m, was subjected to technogenic impact;
b) With an equivalent technogenic load, highly permeable deposits are characterized by minimal concentrations of polluting indicators. This position corresponds to the floodplain of the Akhangaran River, where groundwater is lithologically unprotected, on the other hand, it is well protected in hydrodynamic respect and is in a satisfactory ecological condition;
c) In the lower part of the Akhangaran river valley, the tendency of water quality changes towards deterioration dominates in conditions of moderate groundwater protection, the ecological state is moderately satisfactory;
d) Within the development of groundwater on loess-like loam and sandy loam in conditions of difficult water exchange, the ecological state of groundwater is unsatisfactory.

Water protection measures in the identified areas with different ecological conditions are as follows:

1) For areas with favorable ecological conditions (right-bank parts of the Akhangaran river valley), it is recommended to carry out preventive water protection measures. This is to prevent the full use of the dilution capacity of the soil flow. There should not be placed facilities using technology using accumulators of liquid waste, from which highly concentrated wastewater is filtered (chemical, metallurgical, bast and other plants).
2) For areas with a conditionally favorable ecological state, where a negative trend of deterioration in quality is currently outlined, it is required to prevent the construction of new large industrial facilities. In existing industrial enterprises, it is necessary to clearly organize the accounting of water consumption and strict regulation of its consumption, to take measures to combat losses and leaks.
3) For areas that are already polluted and, by their natural position, have substandard waters of an unfavorable ecological state, it is recommended:

a) At industrial sites, take measures to improve the hydrochemical situation;
b) An increase in the degree of wastewater treatment at treatment facilities;
c) Improvement of technological processes (use of a closed cycle of water use);
d) Development of production along the path of reducing the technogenic load on the environment, including the state of surface and ground waters.

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