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THE APPLICABILITY ASSESSMENT OF TECHNICAL SOLUTIONS FOR A FEASIBILITY STUDY ON THE PURIFICATION OF GROUNDWATER IN THE ILEK RIVER VALLEY FROM BORON FOR THE MODERN HYDRO GEOCHEMICAL SITUATION

This scientific article is devoted to the problem of pollution of the Aktobe basin with boron by the waters of the Ilek River, which drains contaminated groundwater. In connection with not full implementation of the decisions taken to reduce the concentration of pollutants, in particular boron, the problem of groundwater pollution is exacerbated. The monitoring datas fix the increased level of pollution. Initiative field studies and the results of the determination of sampling samples showed an excess of threshold limit value of boron both in the zone of the old sludge accumulator and in the Aktobe basin. To justify the need to develop and implement a qualitatively new approach to the solution of the problem of groundwater contamination in the Ilek river valley and the Aktobe Basin, boron made estimates for the topographic and hydrogeological, combined with the technical solutions, the feasibility study, maps. It is shown that now the front of groundwater pollution from the industrial site and the new sludge collector has approached the river, and therefore the technical solution of the feasibility study for the second section no longer corresponds to reality. The dynamics of the pollution processes of the Ilek River in the old sludge accumulator zone is analyzed. Based on the regression model, a forecast is made of the changes in boron content in the right bank of the Ilek River. It is shown that the technical feasibility study on the first site requires a revision.

As a new approach to solving the problem, it is proposed to develop a system from a constantly operating model of geo-filtration and a model of turbulent macro diffusion combined with it. Mapping izoconcentrate of boron and other pollutants of groundwater will provide an opportunity to consider them from the standpoint of alternative environmental technologies, for example, as the basis of boron fertilizers.

Key words: ground water, pollution, boron, basin, feasibility study.

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Қазіргі Елек өзен алқабының жер асты суларының гидрогеохимиялық жағдайы үшін бордан ластануынан техникалық-экономикалық негіздеудің техникалық шешімдерінің қолайлығын бағалау

Берілген ғылыми мақала ластанған жер асты суларына жинақталатын Елек өзен суларымен Ақтөбе су қоймасының бормен ластану мәселесіне арналған. Ластаушы заттардың, соның ішінде бордың, концентрациясын төмендету бойынша қабылданатын шешімдердің толық жүзеге асыралмағанынан, жер асты суларының ластану мәселесі екпінделуде. Бақылау ақпараттары ластанудың жоғарғы деңгейін белгілеуде. Бастамалы далалық зерттеулері және іріктелген үлгердің талдау нәтижелірі алғашқы қалдық қойма зонасында, сонымен бірге Ақтөбе су қоймасында да бордың ШРК көрсеткішінен артық екенін көрсетті. Елек өзен алқабының жер асты суларын және Ақтөбе су қоймасын бормен ластану мәселесін шешу мақсатында сапалы, әрі жаңа әрекеттердің дайындалуы және оның жүзеге асырылу қажеттігін негіздеу үшін техникалық-экономикалық негіздеудің техникалық шешімдер сызбасымен қатар топографиялық және гидрогеологиялық карталар негізінде есептеулер жүргізілді. Өндіріс алаңы мен жаңа қалдық қоймасынан жер асты суларының ластану аймағы өзенге жақын келгені көрсетілді, сол себепті екінші алаң үшін техникалық-экономикалық негіздеудің техникалық шешімдері нақты түрде жүзеге асырылмайды. Алғашқы қалдық қоймасының алаңында Елек өзенінің ластану үдерісінің динамикасы талданылды. Регрессиялық модель негізінде Елек өзенінің оң жағалауында бор құрамының өзгеруі болжамдалды. Техникалық-экономикалық негіздеудің техникалық шешімдері бірінші алаң үшін де қайта бақылауды қажет етені қарастырылды.

Берілген мәселені шешуде жаңа әрекет ретінде үздіксіз әрекеттегі геофильтрациялық және онымен бірге қолданылатын макро диффузияның турбуленттік моделінен құралған жүйесін дайындау ұсынысы берілген. Жер асты суларындағы бордың және басқа да ластаушы заттардың изоконцентраттарын картаға түсіру баламалы табиғат қорғау технологиялардың бағдары, мысалы бор құрамды тыңайтқыштар негізі ретінде қарауға мүмкіндік береді.

Түйін сөздер: жер асты сулар, ластану, бор, су қоймасы, техникалық-экономикалық негіздеу.

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Оценка применимости технических решений технико-экономического обоснования по очистке подземных вод долины реки Илек от бора для современной гидрогеохимической обстановки

Данная научная статья отведена проблеме загрязнения Актюбинского водохранилища бором водами реки Илек, которая дренирует загрязненные подземные воды. В связи с не полной реализацией принимаемых решений по снижению концентрации загрязняющих веществ, в частности бором, проблема загрязнения подземных вод обостряется. Мониторинговые данные фиксируют повышенный уровень загрязнения. Инициативные полевые исследования и результаты определения выборочных проб показали превышения ПДК бора как в зоне старого шламонакопителя, так и в Актюбинском водохранилище. Для обоснования необходимости разработки и реализации качественно нового подхода к решению проблемы загрязнения подземных вод долины реки Илек и Актюбинского водохранилища бором выполнены ориентировочные расчеты по топографическим и гидрогеологической, совмещенной со схемой технических решений технико-экономическое обоснование, картам. Показано, что сейчас фронт загрязнения подземных вод от промплощадки и нового шламонакопителя приблизился к реке, а потому техническое решение технико-экономического обоснования по второму участку уже не соответствует реальности. Проанализирована динамика процессов загрязнения реки Илек в зоне старого щламонакопителя. На основе регрессионной модели выполнен прогноз изменения содержаний бора в правобережье реки Илек. Показано, что и техническое решение технико-экономическое обоснование по первому участку требует пересмотра.

В качестве нового подхода к решению проблемы предлагается разработка системы из постоянно действующей модели геофильтрации и совмещенной с ней модели турбулентной макродиффузии. Картографирование изоконцентрат бора и других загрязнителей подземных вод обеспечит возможность рассмотрения их с позиций альтернативных природоохранных технологий, например, как основы борсодержащих удобрений.

Ключевые слова: подземные воды, загрязнение, бор, водохранилище, технико-экономическое обоснование.

Introduction

Population growth, development of economic activity, growth of living standards increase water consumption and wastewater volumes with the amount of pollution in them. This situation leads to increasing competition and conflicts between different water users. According to the United Nations (UNDP, 2016: 4-9), globally, more than 2 billion people of different countries live in conditions of extreme water shortage, defined as the ratio of total freshwater consumed to the total volume of renewable freshwater reserves above the threshold of 25 percent (Sustainable Development knowledge Platform, 2015). Therefore, the study of imbalance of ecological systems in the presence of contamination presupposes a detailed knowledge of the pattern of the spread of pollutants in the lakes and water streams (OECD, 2012: 25).

Pollution of groundwater and surface waters by boron in the Ilek river valley and Aktobe basin the sources of water supply in Aktobe region - has an impact on the socio-economic development of the region and the formation of an ecological situation in the territory of the Russian Federation. The Ilek River is trans boundary, it flows into the Ural River and eventually the polluted waters enter the Caspian Sea, to the spawning grounds of sturgeon (Pavlichenko, 2017: 967-974).

In the feasibility study on the purification of contaminated groundwater by boron in the valley of the Ilek River, developed at the Center for Health Protection and Environmental Projecting based on the monitoring of underground waters conducted by LLP «Akpan», technical solutions for the interception of contaminated groundwater have been developed. These decisions were developed in 2008 and reflect the hydro-geodynamic situation for 2005, as monitoring observations were discontinued due to lack of funding (Korchevskij, 2008: 86-132).

Although the feasibility study takes into account the results of the field research conducted by the Center for Health Protection and Environmental Projecting in 2007 and 2008, which made it possible to clarify and expand the list of main sources of pollution, the regulatory deadline for its implementation has exceeded in 2015. The feasibility study revision project in 2015 was reduced to a recalculation of the estimate taking into account new financial indicators. Work on the implementation of technical solutions did not even begin on the pilot site recommended by the state expertise.

Initiative field research by the authors, carried out in July 2017 and showing that the threshold limit value (TLV) were exceeded both in the old sludge accumulation zone and in the Aktobe basin, which had not been observed before, clearly demonstrate the relevance of the boron pollution problem of the Ilek river and the Aktobe basin.

The purpose of this work is to analyze the hydro geodynamic and hydro geochemical changes in the Ilek river valley in the Alga region (Aktobe) in order to assess the applicability of technical solutions for feasibility studies in modern conditions.

Material and methods of research

The actual data of the annual monitoring by KazHydroMet (Information Bulletin, 2008-2017); the visual observations of the research area; the results of chemical composition research of surface water samples, and cartographic materials were used for the analysis of the current situation. In addition, for more clarify of ecological situation of Aktobe region were applied the materials of the Feasibility Study by the Center for Health Protection and Environmental Projecting, and the Ministry of Environmental Protection of the Republic of Kazakhstan in 2007-2009 period project; report of LLP “Akpan” for 2005.

The study the hydro geochemical situation in the of the Ilek river valley based on the following methods (Krauskopf, 1994: 280-331; Tahoora Sheikhy, 2014: 455):

Comparative geographical analysis of photographic materials for the period of 2008 and 2017;

Approximate calculations of the advance of the groundwater pollution front for the period 2005-2017;

Expert analysis of the role of causes of pollution of groundwater on the right bank of the river;

Regression analysis for predicting the timing of self-purification of groundwater on the right bank of the river (Allan Freeze R., 1979: 28-261).

In the report of LLP “Akpan” for 2005, the old sludge accumulator was allocated as the main source of pollution of the Ilek River and there was a small role of soils contaminated by the emissions of the Aktobe chemical factory (in Alga) as a result of their washing with atmospheric precipitation. At the same time, it was believed that the new sludge accumulator and industrial site do not make a significant contribution to pollution, due to their location in areas with low filtration parameters. This point of view is shown in Figure 1, a hydrogeological map with the allocation of zones of various levels of pollution of the underground waters of the Ilek valley by boron.

However, the results of additional partial testing of the monitoring wells, which conducted in 2007 and 2008, for clarify the nature of the pollution of the Ilek river hexavalent chromium and boron research allowed clarifying and expanding the list of major sources of groundwater pollution by boron (Korchevskij, 2008: 31-58).

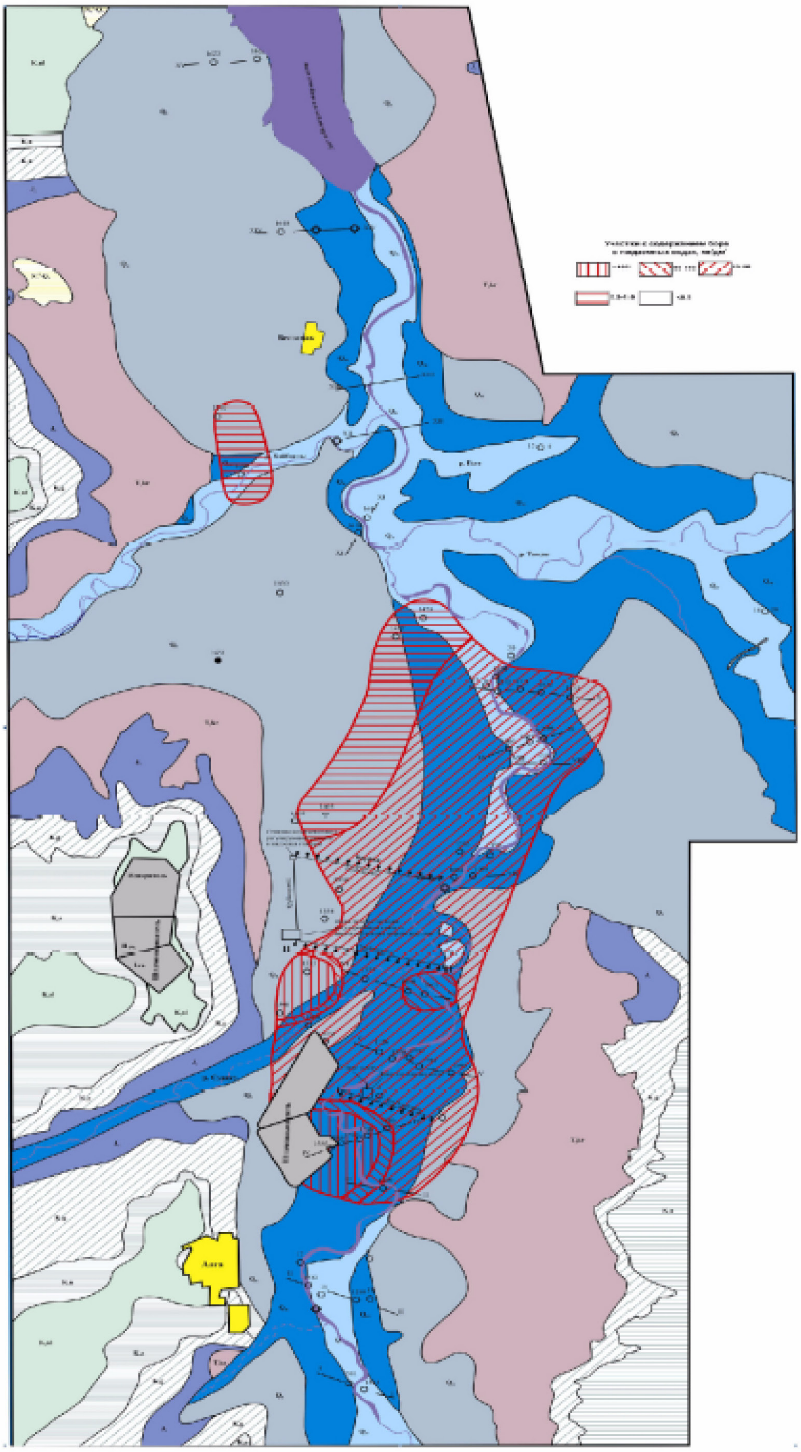

Figure 1 – Hydro geological map of the valley of the Ilek river (LLP «Akpan», 2005) with a Projecting plan for the purification of groundwater from boron (The Center for Health Protection and Environmental Projecting, 2009)

The changes were entered in the scheme for interception of contaminated groundwater (Figure 2) after the analysis of the results of fieldwork in 2008, drilling of wells in the area of old and new sludge accumulators to assess the possibility of filtration through their bottom. In addition, Figure 3 shows the zoning scheme of the underground waters of the valley. This scheme was derived after the construction of a new map of hydro geochemical zoning by GIS methods, taking into account all monitoring wells and without taking into account the assumptions of previous researchers on the existence of a geochemical barrier not confirmed by actual hydrogeological data.

Figure 2 shows the wells of the network and the main infrastructure of the factory – sludge collectors, the territory of the plant and the city of Alga. Unfortunately, this map does not indicate the slurry lines from the plant to the new sludge collector (the old pulp was fed through a metal pipe). The outlines of the city on this map correspond to its current position, while in Figures 1 and 3 these outlines are taken from the old topographical basis. Taking into account the fact (Appelo, 2005: 35-139) that the territory of the industrial site of the factory is now practically next to the city that has grown after the old sludge collector was preserved, Figure 3 clearly reflects the direction of groundwater flows from the industrial site, slurry pipelines and a new sludge accumulator.

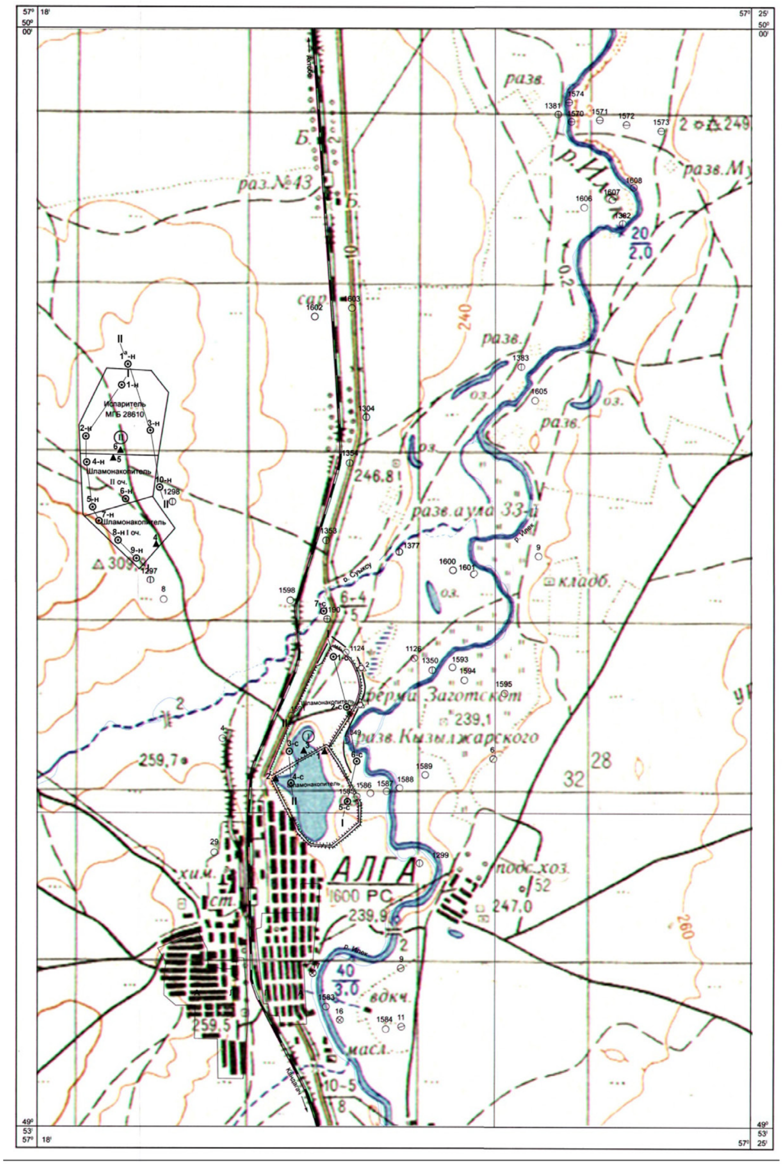

Figure 2 - Map of the actual material of the work area of LLP "Milysai", 2008.

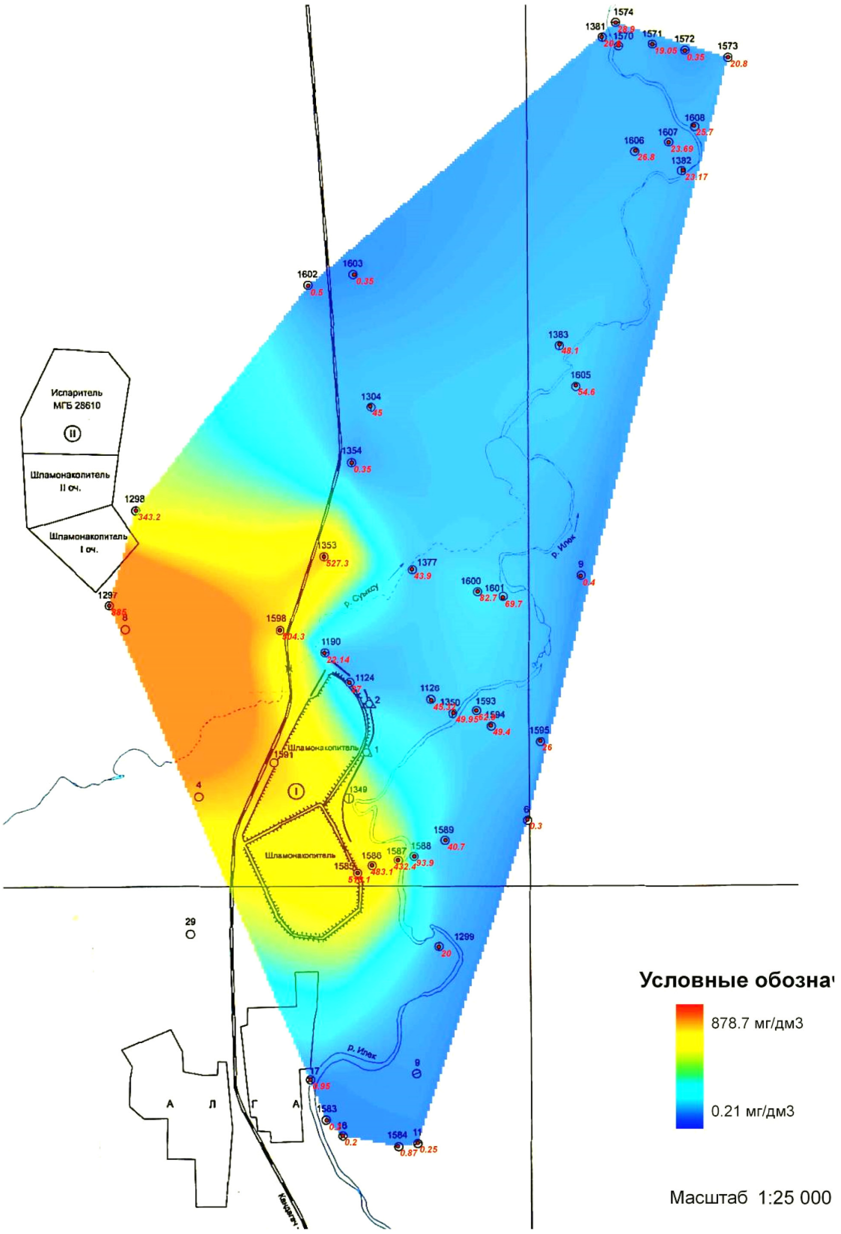

Figure 3 – Scheme of zoning of groundwater in the Ilek valley in 2005.

The report (Yakovleva, 2004: 53-192) provides information on the number of production wastes recorded as of 01.01.2000 - on the industrial site of the former plant: waste of boron production - 647.3 thousand tons, solid and solid waste - 273 thousand tons, cinder - 53 thousand tons, vanadium catalyst - 2.2 thousand tons. It is clear that such the amount of waste that was openly stored on the industrial site after the plant was shut down in 1998 could not but affect the concentrations of groundwater.

The role of slurry pipelines and production wastes in groundwater pollution can be assessed visually from the photo (Figures 4 and 6), and the process of pyritic cinder utilization is shown in Figure 5.

The main direction of groundwater movement on the left bank of the Ilek River in the area of storage ponds of the Alga Chemical Factory from the southwest to the northeast towards the river. Hydraulic gradients here are 0.0015-0.002, the coefficients of filtration of water-bearing Quaternary sand deposits are 30-35 m/day. A maximum of concentration near the «old» storage pond is associated with this groundwater flow and a maximum spatially located east of the “new” storage pond (Figure 3).

Figure 4 – Pipeline condition with traces of emergency discharges

Figure 5 – Pyrotechnic plant with a pyrite heap dump

Figure 6 – Sacks with brown (marking 1990), stored in the open air

Based on the analysis of the data (Information Bulletin, 2008-2017) of long-term monitoring of boron contamination of groundwater and surface water in the Alga-Aktobe region, and analysis of hydrogeological material and experimental studies, and accounting for project changes in the dynamics of groundwater and surface water:

The main sources of pollution forming a hotbed of groundwater contamination with high boron concentrations are the old sludge accumulator, traces of emergency slurry leakage and the new sludge accumulator (Vengosh, 1994: 1968-1974), the former chemical factory industrial site and soil contaminated with the former chemical factory emissions, dust from the dried surface of the sludge accumulators, places of emergency leakage of the slurry pipeline and settled on the shore silt after spring floods;

The wedging of contaminated groundwater into the Ilek River, where boron is sorbed by silt settling in the Aktobe Basin, creates a high risk of transformation of the Aktobe Basin into a new source of contamination of the infiltration water intakes of the city of Aktobe located below its dam. In the high water years, the processes of wave formation and rising of settled silt are intensified, which can increase the concentration of boron in surface waters and infiltration water intakes below the dam. The Ilek River is the basis for the erosion of the valley, that is, it determines the line of the lowest pressure of the groundwater. In this regard, the spread of boron on the right bank of the Ilek River in the area of the «old» storage pond becomes not entirely clear. If the transfer of boron was carried out only by the flow of groundwater, it could in principle not come here without additional causes, which change the flow hydrodynamics. The method of solving this problem is based on the analysis of the role of the «wall in the ground» by comparing the additional pressures created by the «wall in the ground» and the depth of the groundwater table.

Table 1 presents the results of drilling operations and the pumping of some of the conserved monitoring wells.

Table 1 – Journal of pumping and sampling of water from observation wells of the regime network behind groundwater contamination by boron in the valley of the Ilek river near the Alga region

№№ well	The water level (from the mouth of the column), m	Depth of bottom hole (from the mouth of the column), m	Depth of installation of the pump (from the mouth of the column), m	Debit, dm^3/s	Sample volume, dm^3	Height of the branch pipe, m
1190	4,16	15,42	15,2	0,1	3,0	0,7
1585	3,19	25,19	25,0	0,6	3,0	1,0
1586	2,05	31,4	18,6	0,3	3,0	0,61
1587	2,46	4,4	4,4	0,1	3,0	0,4
1588	3,47	10,07	10,07	0,4	3,0	0,66
1297	5,38	16,9	16,9	0,1	3,0	0,45
1350	2,25	14,6	14,6	0,3	3,0	0,4
1299	2,43	31,5	31,5	0,7	3,0	0,7

It is established, that in the area of sludge accumulators the river drains intensively underground water contaminated with boron. The consequence of this is the pollution of the river and the Aktobe basin. The main ways of entering boron into groundwater are filtration through the bottom of the old sludge accumulator, infiltration into the aquifer of contaminants washed away by snowmelt waters and storm drain from the sources listed (Herbert Allen E., 1993: 15-285).

Concentrations of boron in groundwater and in aqueous extracts of old and new mud sludge, selected from depths of more than one meter, exceed 1900 mg/dm^3. High concentrations of boron are also noted in the soils under the bottom of not only the old but also the new sludge collector. These studies showed a far from complete completion of the stage of natural washing of sludges and the presence of a large number of active sources of pollution on the left bank of the Ilek River. In the research work (Pavlichenko, 2012: 96-104) the graphs of changes in boron concentrations in wells of section IV-IV demonstrated a short duration of Functions to prevent filtration from the «old» sludge collector. After the beginning of the filtration, bypassing the "wall", the head is reduced, and the character of the change in boron concentrations in the wells on the right and left banks is clearly manifested. The initial data for the construction of regression dependence for predicting the self-purification of groundwater on the right bank can be the regime during the monitoring period, supplemented with the results of testing in 2008. The actual material for justifying the solutions is presented in Table 2.

Table 2 – The content of boron in groundwater in the zone of the old sludge accumulator in line IV-IV

№ well,	Maximum values in wells by years													
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1585	387	350	385,1	69,4	84,7	61,5	54,4	267,4	395	290	291	271,3	510,1	143,26
1586	631,3	659	633	61,6	61,6		46,2	62	383	294	302	268,4	483,1	141,3
1587	469	487,7	373	74,9	58	66,6	66,6	273,7	374	292	297	267,3	432,4	137,5
1588	260	216,7	262,1	67,3	57,9		61,5	258,5	244	228	224	137,2	93,9	43,17
1589	34,7	48,6					56,9	276,3	288	247	234	170,6	79,6	45,4

Research results and discussion

Calculation of distances covered by the front of groundwater pollution. In the work (Pavlichenko and others, 2012), the approximate rates of movement of the groundwater contamination front are calculated, calculated from the time of passage of the maximums of boron concentrations in the groundwater between two observation wells. The rate of advance of the lowering of the concentrations (and, consequently, of the pollution front) will be about 300-500 m per year, depending on the slope of the surface. In this case, according to Figures 1 and 3, it could be seen that the distance from the front to the series of drainage wells II-II is approximately 1.4 km. While for 13 years (from 2005 to 2017) the front of pollution can pass a distance of 3.9 to 6.5 km, i.e. The planned drainage strut II-II of 2,100 m in length has already been fully completed in the middle of 2015 (1.4 + 2.1 = 3.5 km> 3.9 by the end of 2017). Thus, the flow of groundwater of the western direction is already wedged out in the Ilek River, and the technical solution in the feasibility study for Section-2 no longer makes sense.

The reasons for the spread of the source of groundwater pollution to the right bank. In the project on the assignment, the Ministry of Environmental Protection of the Republic of Kazakhstan in 2007-2009 yy, it is indicated that the reasons for boron to enter the right bank may be spills of contaminated groundwater during floods, dust transport of contaminated soil and sludge. However, during the floods, the contaminated groundwater is diluted with snowmobiles, and dust transfer calculations have shown their insignificant influence, especially since the drilling of ecological and hydro-geological wells in the territories of both old and new sludge accumulators, the sludge in them was practically washed to a depth of 1 m.

Consequently, the only real reason for hitting the boron on the right bank can only be a support from the wall in the ground. The modern hydrodynamics of the old sludge storage system in the ground by 2008, does not accurately reflect the situation when the wall created the maximum backwater from the initial level, the ground waters reached the surface of the sludge accumulator and filtration not only around it began unfinished part, but also through imperfections and gaps in the existing part.

If the Ilek River were a perfect drain, that is, it would intercept the entire capacity of the groundwater aquifer, an increase in pollution after the breakthrough of the “wall” on the right bank would not have been observed. However, on the hydrogeological map of LLP “Akpan”, the focus of pollution was noted on the right bank. Such a situation may indicate the presence of a hydraulic connection between the left and right ground flows, that is, the presence of a creek stream that transmits an increase in absolute marks (a decrease in the depths of groundwater) to the right bank.

In accordance with the topographic (Figure 2), the difference in the absolute marks of the surface in the locations of the wells on the left and right banks does not exceed 2 m (Table 3), and the maximum support from the “wall” was 2.41 m. If there is a pollutant stream with an increased gradient of backwater will move to the right bank.

Table 3 – Calculation of absolute marks of groundwater levels for alignment IV-IV

№, well	Depth of layer		Absolute marks		
				Groundwater levels	
	1990 years	2008	Surfaces	1990	2008
1585	2,41	2,19	241,74	239,33	239,55
1586	1,49	1,44	240,74	239,25	239,3
1587	2,21	2,06	240,05	237,84	237,99
1588	3,37	2,11	239,95	236,58	237,84
1589	1,51		239,86	238,35	239,86

After the beginning of the flow around the «wall», the head was noticeably reduced, but a small decrease in the depth of occurrence is fixed in all the wells of the observation section IV-IV even 10 years after the beginning of the flow around the «wall» (Table 3).

A visual representation of the character changes in boron concentration in wells of this alignment could be obtained from figure 7.

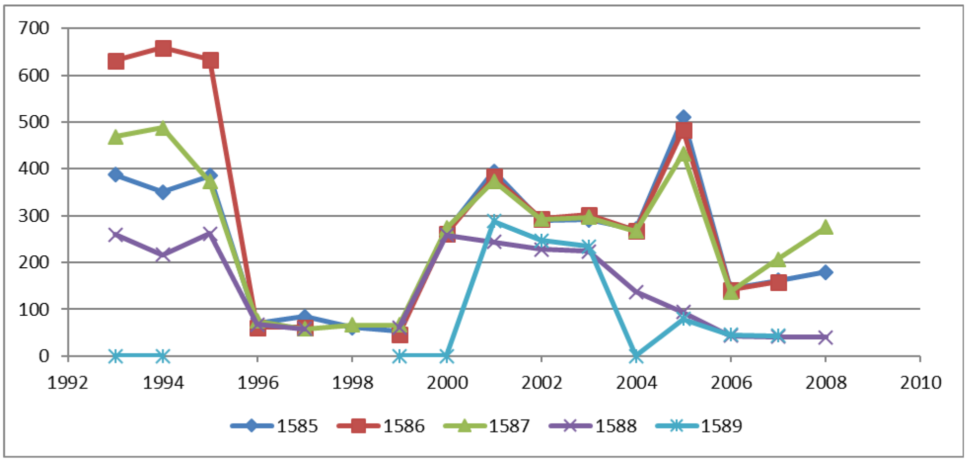

Figure 7 – Dynamics of changes of the boron concentrations in the wells of observation section IV-IV

As can be seen from the figure, after the completion of the "wall in the ground" construction in 1994, the reduction in boron concentrations begins in 2 years in wells 1585-1588. Its "wall" holds its full function in the period 1996-1999, while there is an ecological filtration capacity between the sludge collector and the "wall", and then the boron concentration sharply increases, but does not reach its initial values.

Further, the fluctuations of the concentrations are determined by the water content of the year, but in all left-bank wells, despite these fluctuations, there is a very slight trend of decreasing boron content, increasing the difference in concentrations, and after 2003. While the impact of backwater was affected (until 1999 for 1588 and 2000 for 1589 wells), the nature of left-bank well curves repeat the curve of the left-bank wells. After 2000 for 1588 wells and after 2003 for 1589 the character of the curves completely changes – for them it is possible to note a clear orientation to a constant decrease in boron concentrations.

Moreover, we can note one more feature of this period - the concentration of boron in 1588 and 1589 wells become practically the same that is now it is the process of drainage of the left-bank flow without the influence of backwater. In addition, this means that it is possible to construct a regression equation for the prediction of reduction of residual amounts of boron in right-bank wells due to washing with atmospheric precipitation and snowmelt waters.

Verification of different variants of the trend equations showed for the well 1588 the maximum value of the curve approximation (0.925) by the fourth-degree polynomial equation.

In this case, the concentration of boron, equal to 0.486 mg/dm^3, will be reached in 2020. Since the concentration of boron, less TLV, will be achieved in 2-3 years, there is no sense in implementing the construction of seven right-bank wells of the first section of the feasibility study.

After the development of the project, since it was shown above that in the nine years, the second section will not be able to intercept the entire flow of contaminated groundwater from the industrial site of the former factory. The traces of emergency pulp spills when transporting it to the new sludge accumulator and filtering out of it, the feasibility study no longer corresponds modern hydrodynamic environment.

The acute problems of the pollution of the Ilek River and the Aktobe Basin are emphasized by the monitoring data of «KazHydroMet», which fixes the increased level of pollution, and the initiative field studies and the results of determining the samples (GOST, 2014) by authors, conducted in July 2017. The chemical analysis of water samples was carried out at the Hach-Lange LZV 735 analytical laboratory for water analysis based on the DR 1900 spectrophotometer (Manual, 2013). As a result, there is an excess of the threshold limit value of boron (GOST, 1998) in the area of the old sludge accumulator (7.5 mg/dm^3 - 15 TLV), and in the Aktobe basin (1.2 mg/dm^3 - 2.4 TLV). In addition, on the territory of the Aktobe city, that is a lower excess (0.6 m /dm^3 - 1.2 TLV below the dam). However, it has always been assumed that boron is precipitated by silt in the Aktobe basin almost completely, in other words within the city the boron concentration should be below the TLV.

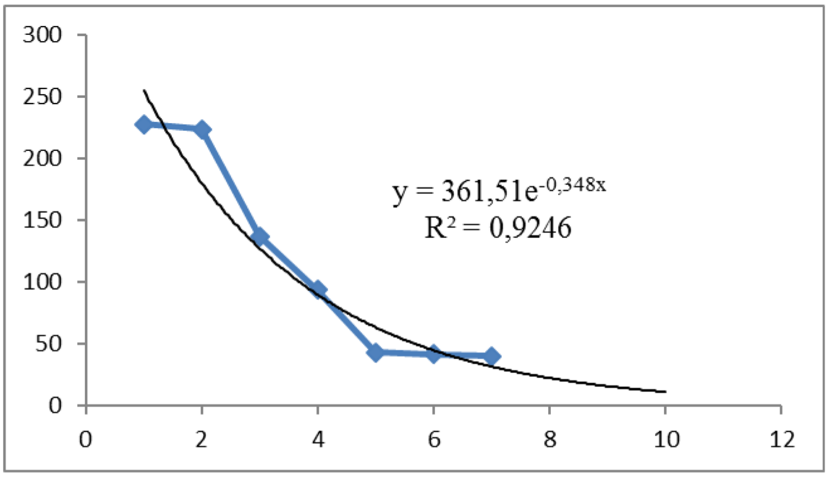

Figure 8 – The exponential approximation of the dynamics of boron concentrations in the well 1588

These excesses are already defined by the new sanitary rules (Legal Information system, 2018), which is now assumed to be 0.5 mg/dm^3 in all cases, although until recently all the rivers used the Fishery Ecology limit equal to 0.017, that is, stricter in 29 times.

An additional indicator of the deterioration of water quality in the Aktobe basin is the results of a social survey of children swimming in the basin. Now, more often after bathing on the skin, rashes and itching appear which determines the obvious signs of boron exposure.

It is known that boron is an essential element for plants; therefore, a large number of species of boron-containing fertilizers are produced (Drahomír, 2015: 5-69). These fertilizers also contain phosphorus, potassium, calcium, sometimes sulfur, and other elements (Grimes, 2012: 11-12). Although monitoring of groundwater before 2005 was conducted only by boron, the studies of the Center for Health Protection and Eco-Projects in 2007-2008, in the part of the samples, a high content of phosphorus, fluorine, nitrates and sulfur anions is established. Since the content of boron above 30 mg/kg of soil also has a negative effect, it will be very important to divide the left bank along the concentrations of boron, phosphorus and other fertilizer components. This will make it possible to analyze the perspectives of using contaminated groundwater for growing fodder crops and organizing livestock complexes, since boron was not found in meat of animals with high concentrations, and the estimated probabilities of diseases of the population from eating local animals were very low.

To identify areas that are promising for this alternative approach, detailed schemes of the isoconcentrate of groundwater pollutants, which could be used as components of boron fertilizers with which additives are needed, require the construction of a model system.

However, there are many problems along this way. The issue of assessing the pollution of surface waters contaminated by underground refers to a complex and poorly developed field of «interdisciplinary» research. It determines the practical absence of mathematical models that allow for taking into account the pollutant transition from groundwater, where its transfer is subject to hydrogeological laws (the presence of dynamic porosity, changes in the volume of underground runoff, weak or total absence of the influence of atmospheric precipitation), a watercourse or a body of water, where hydrological laws.

That is why the task of assessing the interconnection of surface and groundwater in the part of the transfer of pollution by underground waters and their transfer to water bodies and watercourses is not solved unequally. Migration of pollution with groundwater is studied and evaluated usually based on geo-filtration and geo-migration models, in other words with a significant spatial and temporal detail of the flows of groundwater carrying pollutants. The area of modeling the dynamics (Rodrigo, 2014) of the quality of surface waters, in view of the large variability of runoff characteristics, is not sufficiently developed.

Conclusion

The problem of pollution of the Aktobe basin with boron waters of the Ilek River, which drains contaminated groundwater, is constantly exacerbated, since none of the decisions taken have been fully implemented. Now the front of groundwater pollution from the industrial site and the new sludge collector has approached the river, and the formation of the Ilek River near the “old” sludge collector aggravated the situation.

To identify areas that are promising for this alternative approach, detailed schemes of the isoconcentrate of groundwater pollutants, which can with which additives serve as components of boron-containing fertilizers, require the construction of a system from a permanent model of geo-filtration and a model of turbulent macro diffusion combined with it. The development of conditions for combining hydrogeological and hydrological models (Rodrigo Ilarri, 2016) should be carried out using a multidimensional statistical model (component analysis) to identify the interrelationships of surface and groundwater.

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