

REVIEW on dissertation
of **Rysmagambetova Aina Akanovna** on the title -
**“Assessment of the boron pollution dynamics of the groundwater and
surface water of Ilek river valley”** provided to the defense for the degree of
Philosophy Doctor (PhD) in the specialty «6D060800 - Ecology”

1. Relevance of the research topic and its relationship with the general scientific and national programs.

At the present stage of economic and social development the issue of water security in the limited and vulnerable water resources of Kazakhstan is considered as a threat to the national security of the state. The progressive pollution of river basins as a result of the anthropogenic activity of urban and industrial facilities is one of the most urgent problems of modern environmental science. The transport of pollutants by watercourses causes a number of problems not only environmental, but also regulatory, economic, which require the development of methodological support to determine the environmentally maximum permissible load in the catchments of river basins.

The Ilek river is the main source of water supply for the population and all objects of economic sectors in the Aktobe region. A significant role for the population life is played water quality deteriorates annually in in the Aktobe reservoir on the Ilek river, regulating the water supply of the region by releases from it into the river basin. According to KazHydroMet, Aktobe region is one of the six regions in Kazakhstan in terms of highest pollution, environmental problems. Along with others, include high levels of pollution with hexavalent chromium and groundwater boron in the Ilek river valley. Some major sources of pollution in the Aktobe region are historical. Ecologists have been talking about these problems for decades. This is due to the launch in 1937 of the largest Chemical Factory in the USSR at that time in the city of Alga, and in 1957 the Aktobe Factory of chromium compounds. Although the Alga factory has been closed since the late 1990s, and new sludge collectors have appeared at the factory of chromium compounds, they still remain the main sources of groundwater and the Ilek river pollution with boron and hexavalent chromium.

In the period 2012-2013, a project was carried out to purify groundwater from hexavalent chromium in the experimental area. For the prevention boron pollution, no work has been carried out. At the present time, the Department of Ecology jointly with the Akimat of the Aktobe region plans to resume the project for cleaning the Ilek River. Reviewed scientific research allows give evidence-based recommendations for such work on the Ilek river.

Based on the above view, we consider that the topic of reviewed work aimed at solving the problems of cleansing the Ilek river from boron is very relevant for Kazakhstan. The dissertation on the topic **“Assessment of the boron pollution dynamics of the groundwater and surface water of Ilek river valley”** is aimed at solving one of the most important systemic reforms of the Strategic Plan for the Development of the

Republic of Kazakhstan until 2025, approved by Decree of the President of the Republic of Kazakhstan dated February 15, 2018 No. 636) "*Green*" economy and environment. "... The problems associated with the state of the environment remain unresolved: land degradation, water scarcity, high levels of air pollution in cities, and utilization of household waste."

2. The scientific results and their validity.

The validity and reliability of the obtained results is confirmed by the results of processing and analysis of a large amount of information, including a systematic analysis of long-term information and analytical materials and operational observations for various periods of the RSE "KazHydroMet", LLP "Center for Health and Environmental Engineering, scientific and practical reports of various organizations including the Kazakhstan Agency for Applied Ecology (KAPE), the Kazakh Research Institute of Mineral Raw Materials on the research report of Geophysical Production Association "KazRudGeologiya", etc. The results of field work and analytical studies systematized as a result of cameral processing were used, obtained personally by the author during the period from 2016 to 2019.

1 result. The change in the filtration conditions of groundwater contaminated with boron in an initially acidic medium to the filtration in a modern alkaline medium was established based on a series of tasks using a multidimensional statistical model of component analysis.

The *reliability* is proved by the results of the subject interpretation of the record of the type of the main components obtained by processing by the component analysis of the actual material from groundwater monitoring data for different periods. The objectivity of the interpretation is confirmed by the results of our own field studies. The initial stage of manifestation of the front of groundwater pollution from a new sludge collector in the Ilek river valley has been revealed and the velocity of its advancement according to the difference in the outlines of the contour of the groundwater pollution source for 2011 and 2012.

2 result. The conditions for the dilution of pollution by groundwater are determined under different wedging out conditions and different background boron concentrations in the surface water of the Ilek River based on the turbulent diffusion model.

The result is established on the basis of numerical experiments in different formulations of the flat task of turbulent diffusion model. The calculated parameters of the model – the characteristics of the river bed and the frequency were taken from official hydrological sources; the volume of wedging out of contaminated groundwater is calculated on the basis of classical hydrodynamic formulas taking into account data on power and filtration coefficients from reports on groundwater monitoring in terms of describing hydrogeological conditions. The insufficiency of the ecological capacity of the Ilek river was established with a 95% frequency for the dilution of contaminated groundwater wedging out into the Ilek River. This result is distinguished by *independence and scientific novelty*, as it was performed for the first time in this region.

3 result. The main measure to prevent pollution of the Ilek river below the dam of the Aktobe reservoir is to extract silts with their subsequent use as fertilizers and to replace the bottom outlet with the overflow method.

The possibility and ecological potential of the proposed environmental protection measure to reduce the pollution of the Aktobe reservoir are substantiated. *The reliability* of the result is proved by all previous studies and developments on pollution control, studied and continued by the author, taking into account the migration features of boron, the dynamics of the progress of groundwater pollution fronts from different sources of pollution and the nature of dilution of wedging out groundwater by the surface flow of the Ilek river based on a series of flat task of the turbulent model diffusion.

At the same time, it is not entirely clear why the author proposes to use the overflow method between the stages of sludge suction.

3. The degree of novelty of each scientific result (position) and the conclusions of the applicant formulated in the dissertation.

The following results were obtained in the work:

1) The change in the filtration conditions of groundwater contaminated with boron in an initially acidic medium to the filtration in a modern alkaline medium was established. This result is distinguished by scientific novelty, since it was performed for the first time for this region using a multidimensional statistical model of component analysis.

2) The insufficiency of the ecological capacity of the Ilek River for the dilution of contaminated groundwater that squeezed into the Ilek River in the presence of background pollution of the Ilek River was first established. The novelty of the result in experimental modeling of turbulent dilution processes. It is concluded that it is impossible to talk about environmental capacity only in relation to the dilution of pollution from groundwater. The discrepancy between the curves along the dilution points up to 1 mg/dm^3 for the solution options with and without background showed that background concentrations consume the ecological capacity of the river.

3) The feasibility of extracting sludge with further use as fertilizers and replacing the bottom outlet with the overflow method has been proved. New methods are proposed for removing boron from the Aktobe reservoir by extracting sludge, followed by their use as fertilizers. At the same time, the author considers unacceptable the option of releases from the reservoir through the bottom outlet, since this creates powerful turbulent turbulence with the removal of boron into the Ilek river below the dam, expanding the zone of pollution by boron. In the same way, the restoration of sludge collectors, proposed by some researchers, will not yield positive results, since it is almost impossible to prevent moisture from entering the sludge from above or to prevent filtering through their bottom into groundwater due to imperfect construction work.

4. Practical and theoretical significance of research results.

Theoretical significance. The complex of methods and approaches used in the work of combining motion models of groundwater and surface water under conditions of

changing intensity of pollution sources is possible to use when solving theoretical problems for other water bodies. Special attention should be paid to the personal contribution of the applicant to the construction and interpretation of the results of multidimensional statistical models and the calculation of parameters and modeling of a series of flat task of the turbulent diffusion model. Studies on the dynamics of groundwater and surface water pollution in the Ilek valley allow us to build a system of environmental protection measures to prevent further pollution of the Ilek basin on a scientific and practical basis.

Practical significance. Certainly, the present dissertation has a wide practical application and orientation. The results of this study showed that a technogenic boron biogeochemical province was formed in the Ilek river, requiring urgent action. The composition of the sources from which water is supplied, the identification and elimination of possible adverse effects of the chemical composition of drinking water on the human body are important factors in maintaining public health.

A component analysis made it possible to forecast the zone of formation of the secondary center of groundwater pollution by boron in the area of the drinking water intake that was not mapped by traditional methods: the accumulation site of the transit boron deposited on the mechanical geochemical barrier was mapped, this result, like others, is of great practical importance.

In the work, its final conclusions indicate the need for measures to eliminate the migration of boron with surface and underground runoff; to reduce water pollution and reduce the concentration of pollutants - the implementation of sanitary-environmental releases, etc. I believe that the complex "The measures to reduce the boron pollution in the Ilek river valley", reflected in Chapter 5 of the dissertation, should be recommended to natural resource management bodies for taking further planned actions to improve the environmental situation in the Aktobe region of Kazakhstan. At the same time, theoretical research materials are of practical interest for the educational process at universities in natural sciences.

5. Comments and suggestions on the dissertation.

Noting all the positive aspects of the dissertation research, it is necessary to indicate **the following shortcomings in the content and design of the dissertation:**

1. A study of the dynamics of the processes of pollution of ground and surface water of the Ilek River, an assessment of the hydrogeochemical situation of the region under study based on component analysis involves the interpretation of hydrochemical data. However, the author uses the data of samples for boron content for different periods of time throughout the territory (tables 1- 4), which is not entirely indicative for a joint analysis of the component content of boron. Perhaps this drawback is not related to the availability of stock hydrochemical data in general, and the author used all possible materials.

2. When studying the natural self-cleaning process of Ilek river before reconstructing the ecological capacity calculated the predicted values of boron concentration on the basis of component analysis, and are given on page 86 of the dissertation. The calculations and

assumptions of subsection 3.5 are made that the processes of natural cleaning from the effects of only the old sludge collector can only restore full ecological capacity by 2080. These findings are not included in the general conclusions of Chapter 3, are new and suggest that they deserve additional attention.

3. From the above information (graphs and screen shots) of subsections 4.2-4.3 on the construction of a flat task model for two-sided wedging in the Ilek river of groundwater polluted by boron is not entirely clear how the volumes of surface and groundwater are taken into account.

So on page 100-101 "In the hydrological part of the project, there are data on three gradations of surface runoff frequency (Ilek river) in the alignment of the Aktobe reservoir - 95, 75 and 50% frequency Data on the parameters of groundwater coming out are taken from wedging calculations based on tabular and graphical material according to the results of groundwater monitoring of the Aktobe region for 2010-2012. ... "

At the same time, for one to three years, hydrological information on the hydrological station and water discharge cannot be presented by gradation of availability, not taking into account the long-term dynamics.

4. Separate formulated conclusions at the end of chapter 4 are general and not clearly formulated.

5. It is important to note that the same water quality indicators in the regulatory documents of different countries can significantly differ from each other. For example, in Kazakhstan, for some indicators, maximum permissible concentrations (MPC) are established, which are either outside the sensitivity of modern analysis methods or outside the technologies used for water treatment. Therefore, we believe that the use of foreign experience is, of course, welcome, you give a lot of references to foreign references, but at the same time it is necessary to apply one or another development with great care, in order to avoid false comparisons and conclusions.

Nevertheless, the comments made are mainly of a "factual" character, possibly discussed among ecologists and hydrochemists, a wide range of natural scientists, do not relate to protected provisions, the reliability of the results and novelty, and do not affect the overall assessment of the compliance of the work with the doctoral level (PhD).

6. Compliance with the content of the dissertation within the requirements of awarding degrees.

The main provisions, results, conclusions and conclusions of the dissertation were published in domestic and foreign scientific journals and presented at international and national conferences. Applicant's scientific articles in international reviewed scientific journals are ecologically oriented.

All used stock and published materials of the dissertation have correct references, in accordance with the approved "Rules for awarding the degrees of Doctor of Philosophy (PhD)."

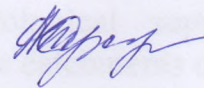
The references correspond to the chosen field of research; many foreign publications are included. The reviewed PhD thesis, in general, has internal unity, the

principle of reliability and validity of the proposed provisions is observed, as evidenced by the use of modern methods of scientific research, using modern computer technology.

Dissertation of Rysmagambetova Aina Akanovna Рысмагамбетовой Айны Акановны on the topic "Assessment of the boron pollution dynamics of the groundwater and surface water of Ilek river valley", which submitted for the degree of Doctor of Philosophy (PhD) degree in the specialty "6D060800 - Ecology" complies with the "Rules for awarding degrees" of the Ministry of Education and Science of the Republic of Kazakhstan, and its author deserves the award of the desired degree.

Reviewer:

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