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INFLUENCE OF BOTTOM SEDIMENTS ON THE FORMATION OF THE QUALITY OF SURFACE WATER

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Introduction. A number of authors have noted that metal compounds are found in high concentrations in the bottom sediments of the coastal areas of rivers and lakes [1,3,4]. At the same time, it was found that under the conditions of changes in the hydrological regimes of water bodies and temperature in different periods of the year, an unequal degree of pollution of bottom water with heavy metals was revealed [2].

It has been shown that bottom sediments contain a significant amount of contaminants that are actively involved in the formation of water quality in reservoirs and have an adverse effect on the course of water self-purification processes [5].

Studies have established that due to the increased content of biogenic elements in bottom sediments, the enzymatic activity of microorganisms is enhanced, which leads to an order of magnitude increase in the mobility of reduced forms of metals with variable valence, such as iron, manganese, copper, molybdenum, cobalt, lead and transition (translocation) from bottom sediments into water [6].

A close correlation has been established between the content of organic compounds and metals in bottom sediments and in the water of irrigation canals and rivers [7,8].

In recent years, more and more close attention of ecologists has been attracted by issues related to the impact on water quality of water bodies of bottom sediments formed in the process of long-term discharge of wastewater by industrial enterprises [9]. Bottom sediments can accumulate significant amounts of microelements of natural and anthropogenic origin, taking an active part in the formation of water quality in surface water bodies. A trend has been established for the accumulation of copper,

iron, zinc, cadmium, cobalt, mercury, and other microelements in the bottom sediments of rivers in the zone of emissions from copper-nickel and copper smelters [10].

The purpose of the research was to establish the role of bottom sediments as secondary sources of pollution of the Akhangaran River and their influence on the formation of river water quality.

Materials and research methods. The studies included sampling of bottom sediments and water from the river. Akhangaran at the site above (background) and below (control point) the discharge of wastewater from the Almalyk Mining and Metallurgical Plant under the conditions of expeditionary trips during the spring and summer hydrological seasons of the year. Bottom sediments were sampled at a depth of 0–5, 10–15, and 20–30 cm from coastal areas of the water body. The composition of bottom sediments and chemical analyzes of water samples taken from the Akhangaran River were carried out by standard methods in accordance with GOST 950:2011 “Sources of centralized domestic and drinking water supply. Hygienic, technical requirements and selection rules.

The work used statistical methods for assessing the reliability of the compared values, correlation and regression analysis of the dynamics of the main indicators of river water quality.

Research results. Bottom sediments are silty formations of a grayish-brown color of complex composition, contained mainly in the coastal sections of rivers along the course of the water.

Over a long period of wastewater discharge into surface water bodies, a phenomenon of dynamic equilibrium arose in the system “bottom sediments - water of reservoirs”, and the processes of migration of elements from bottom sediments into water stabilized. However, this balance is disturbed as a result of changes in the hydrological regime of rivers under the conditions of irrevocable withdrawal of water for the needs of irrigation of agricultural crops, especially from small rivers. Once in water bodies, chemical elements are involved in complex processes of physicochemical and biological migration, which greatly complicate their topography and distribution in water and bottom sediments. The intensity of this impact depends on the hydrological and hydrochemical conditions of the rivers, the physicochemical properties of the elements, their mobility, quantity and migration routes in the aquatic environment.

Our research shows that bottom sediment formation processes are largely determined by the amount of pollution in wastewater, water temperature and seasonality. An increase in the migration ability of microelements from bottom sediments into water in the summer, in our opinion, may be associated with an increase in the activity of microorganisms, the development of anaerobiosis conditions, and an increase in the recovery processes occurring in the “bottom sediments - water of reservoirs” system.

It was revealed that in the bottom sediments, in the section below the discharge of wastewater from the Almalyk Mining and Metallurgical Plant, trace elements accumulate in significant quantities and are distributed unevenly throughout its thickness. The mineral composition of bottom sediments is characterized by the presence of various forms of nitrogen, the most common type of which is nitrates. Copper, zinc and lead are contained, to a greater extent, in the upper layers. And iron and manganese - in the deep layers of bottom sediments (table 1).

Table 1 - Gross content of trace elements and nitrogen compounds in bottom sediments from the Akhangaran River (mg/g)

om			**per**		**ganese**				**l**		**ates**	
ments	age	mu	age	mu	age	mu	age	mu	age	mu	age	mu
см												
5 см												
0 см												

It has been established that the priority content of iron and copper in bottom sediments and in smaller amounts - zinc, manganese and lead.

Under the conditions of the spring hydrological regime, the concentrations of microelements, except for lead, in the water of the control point of the Akhangaran River exceed the maximum permissible concentrations (MPC) established for them. At the same time, in terms of nitrate content, the water quality complies with the regulatory requirements (Table 2).

Table 2 - Influence of bottom sediments of the Almalyk Mining and Metallurgical Plant on the water quality of the Akhangaran River

asons of 2019	ignments	es,	t ^{0}C	ors, mg / dm3 (average data of 3 series of determinations)					
				Zinc*	Lead	Copper	Iron	Manganese	Nitrates
Spring flood	Background	41,2	12,5	0,0001	н/о	н/о	н/о	н/о	0,041
		41,6	12,8	0,0001	н/о	0,22	н/о	н/о	0,041
		42,3	13,7	0,001	н/о	0,27	н/о	н/о	0,042
Spring flood	Control	43,4	12,1	1,008	0,0013	1,31	0,05	0,14	0,44
		43,2	12,2	1,200	0,0011	1,33	0,06	0,13	0,42
		44,1	13,4	1,100	0,0014	1,25	0,06	0,14	0,63
ummer low water	Background	3,50	22,5	0,0054	н/о	н/о	н/о	н/о	0,037
		5,10	23,3	0,0070	н/о	н/о	н/о	н/о	0,046
		5,10	20,1	0,0036	н/о	н/о	н/о	н/о	0,053
ummer low water	Control	3,40	21,9	4,018	0,015	5,44	1,79	0,29	0,81
		3,20	22,5	4,025	0,014	5,52	1,78	0,34	0,84
		4,10	22,9	4,600	0,013	5,47	1,70	0,33	0,85

** MPC: for zinc-1.0 mg/dm3, lead-0.01 mg/dm3, copper-1.0 mg/dm3, iron-0.3 mg/dm3, manganese-0.1 mg/dm3*

In the conditions of summer low water in the control section of the Akhangaran River, the concentrations of trace elements in river water increase significantly, negatively affecting the self-purification of the reservoir and its ecological state. So, the concentration of iron in 5.6-5.9; copper in 5.4-5.5; manganese at 2.9-3.4; zinc by 4.0-4.6 and lead by 1.3-1.5 times exceed the MPC in the water of surface water bodies.

Consequently, metal salts accumulated in bottom sediments are an additional source of secondary pollution of small rivers, the role of which increases in the summer hydrological season.

The established differences in the levels of microelement contamination of bottom sediments and the reservoir indicate the complexity of the internal relationships between them. To identify these relationships and the importance of priority indicators in the formation of water quality in water bodies, we carried out a correlation-regression analysis of the results obtained. The calculation results showed that between the content of elements in bottom sediments and their concentration in the water of the river. Akhangaran there is a direct (r>0.5) correlation (Table 3).

Table 3 - Correlation and regression relationships between the content of trace elements in bottom sediments and their concentrations in the water of the Akhangaran River

Indicators, mg/dm3	Correlation coefficient (r)	Regression equation Y=A+BX*
1	2	3
Zinc	0,89	5,723+0,7369X
1	2	3
Lead	0,73	0,025+0,1627X
Copper	0,95	0,025+0,3548X
Iron	0,99	3,126+0,2295X

Manganese	0,82	0,248+0,1070X
Nitrates	-0,09	-

* *Y-dependent variable (pollution concentrations in bottom sediments);*
A is the free term of the equation;
B-coefficient of regression;
X-independent variable (pollution concentrations in river water).

Iron, copper, zinc, manganese and lead contained in bottom sediments have a strong correlation with their concentrations in the water of the Akhangaran River. The revealed quantitative relationships correspond to linear regression equations of the form Y=A+BX.

Thus, the studies performed have shown that bottom sediments contain specific chemical ingredients of pollution, which are characteristic of the composition and quality of wastewater from non-ferrous metallurgy facilities that discharge wastewater into surface water bodies.

The research results indicate that bottom sediments can affect the formation of water quality in surface water bodies due to the migration of toxic elements contained in them into the water, which confirms the sources of literature. The bottom water contains microelements in amounts exceeding the MPCs established for them, and their concentrations increase in the summer hydrological period of the year.

The results obtained can be used by the territorial bodies of the State Committee for Environmental Protection and the sanitary and epidemiological service to improve monitoring of the ecological state of water bodies, taking into account their possible secondary pollution from bottom sediments.

Findings.

1. The content of elements in bottom sediments varies widely, on average, from 0.01 (surface layers) to 32.1 mg/g (deep layers). It is characteristic that iron and copper in bottom sediments are present in higher concentrations compared to other elements.
2. The gross content of toxic metals in bottom sediments significantly exceeds their concentration in the water of a water body.
3. It has been established that bottom sediments are additional "secondary" sources of pollution of the Akhangaran River, because concentrations of toxic metals in river water exceed their normative values, especially in the summer season.
4. A direct strong correlation has been established between the content of elements in bottom sediments and their concentration in the water of the Akhangaran River (r>0.5).

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