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Issue Article

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ASSESSMENT OF THE ECOLOGICAL STATE OF THE NURA RIVER DEPENDING ON TECHNOGENIC IMPACT OF TEMIRTAU

***Abstract**: Hydrochemical indicators were analyzed on the Nura River section from 2009 to 2018. The relevance of the study was determined by the important recreational, economic and environmental significance of the Nura River. The watercourse crosses areas of intense technogenic impact from the industrial complex of the city of Temirtau, where 6 sampling points were selected for analysis. We studied the change in river pollution as the selected enterprises crossed, and the dynamics of pollution over the years was observed. It was found that in the Nura River there is an excess of the MPC for copper and oil products that are not associated with emissions from the Temirtau industrial complex. But enterprises pollute the river with mercury, zinc, sulfates, nitrite nitrogen. The Nura River maintains a relatively normal dissolved oxygen content in the water, but 1 km higher than the combined wastewater discharge of Arcelor Mittal Temirtau JSC and CMF TEMK LLP there is a sharp decrease in BOD3. (translated article [13])*

***Key words**: monitoring, Nura river, Temirtau, hydrochemistry, pollutants, technogenic impact, nitrite nitrogen, mercury, pollution dynamics, maximum permissible concentration.*
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Introduction

The problem of preservation of ecological well-being and rational use of water bodies is very urgent today both in Kazakhstan and in the world. Monitoring of water bodies, especially those located in the industrial impact zone, is a mandatory component of national environmental programmes and scientific projects [11, 12]. Industry specializing in energy and materials-intensive steel and non-ferrous metallurgy can directly or indirectly degrade the quality of adjacent water bodies and streams [8]. In this connection, in the central regions of the Republic of Kazakhstan, particular attention is paid to the monitoring of the hydrochemical regime of r. Nura. The Nura River is the main water artery of the huge Teniz-Kurgalzhyn Depression. It originates from the western spurs of Kyzyltas Karkaral-Aktau low mountain range at an altitude of 1000...1200 m. The total length of 978 km, catchment area is 55100 km2. The source of the river is the confluence of several small springs. The importance of the river is determined by its recreational, national significance. The Nura River is also the main source of food for the lakes of the Korgalzhinsky Reserve [1, 6, 8].

The purpose of this work was: To estimate the technogenic influence on the hydrochemical parameters of r. Nura in the zone of technogenic impact.

Materials and Methods.

The Nura River flows through two regions: Karaganda and Akmola. The Territory is characterized by a harsh continental and arid climate, with harsh winters, hot summers and low rainfall [4, 5, 8]. The industrial potential of the regions continues to grow, exerting man-made and man-made effects on the surface waters of the Nura river [2, 3, 6].

In this work the section of the river passing through the city of Temirtau is considered. The section of the river passes through the city. In this territory, an industry for the production of energy- and material-intensive steel and non-ferrous metallurgy products has been formed. In connection with the historical development, industrial enterprises of LLP «TEMK» - branch of chemical industry and LLS «Bassel Group» - are located in the western part of the city. In 1000 m in the east of the city there is a large industrial enterprise with a full metallurgical cycle - JSC «Arcelor Mittal Temirtau», LLP «Trek», JSC «CentraI Azia Cement», LLP «Kazakhmys Corporation»» LLP «ZPH Techol», Mirtaurgy», LLP» «Temirtau Color Met».

The main water source, possible for use by economic objects of the city, is r. Nura. Its water resources are used in the production activities of SD JSC «Arcelor Mittal Temirtau», LLP «TEMK», LLP «Kazakhmys Energy» etc. Once used for production purposes, water is discharged back into the water body.

We analyzed the annual averages for the period 2009... 2018. Samples for hydrochemical analysis were taken from 6 sampling points in r. Nura (Table. 1): Samarkand reservoir, point above the combined discharge of wastewater of JSC "Arcelor Mittal Temirtau" and CMF LLP "TEMK", sewage discharge channel of JSC "Arselor Mit Tal Tem and TAHMR" "TEMC", point below the combined discharge of wastewater of JSC "Arcelor Mittal Temirtau" and CMF LLP "TEMK", Mill Dam, 5.7 km below the combined discharge of wastewater of JSC "Arselor Mittal Temirtau" and HMZ LLP "TEM" (1).

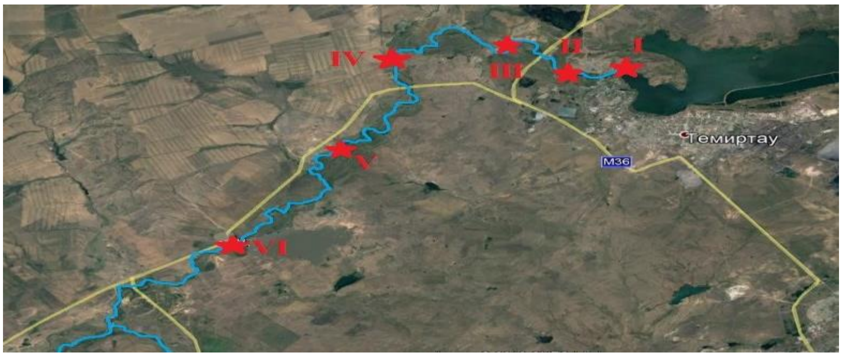

Figure 1. Map of sampling scheme

Table 1. Sampling points for hydrochemical analysis of the Nura River

Selection point	Item number	Co-ordinates
Samarkand podhr, 0.5 km above the dam	I	N 50.106525° E 72.921584°
p. Nura 1 km above the combined discharge of wastewater of JSC "Arcelor Mittal Temirtau" and CMF LLP "TEMC"	II	N 50.103950° E 72.869329°
Channel of joint discharge of wastewater of JSC "Erselor Mittal Temirtau" and CMF LLP "TEMK"	III	N 50.122285° E 72.826040°
p. Nura, 1 km below the combined discharge of wastewater 4 JSC "Arcelor Mittal Temirtau" and CMF LLP "TEMC"	IV	N 50.118453° E 72.744570°
r. Nura, Mill Dam	V	N 50.044638° E 72.693821°
p. Nura, 5.7 km below the combined discharge of wastewater of JSC "Arcelor Mittal Temirtau" and CMF LLP "TEMC"	VI	N 49.975874° E 72.608488°

In aqueous samples, copper, mercury, zinc, manganese, sulphates, petroleum products, dissolved oxygen, nitrite nitrogen, BOD3 were determined and analysed.

Discharges from industrial and utilities treatment plants and accidental discharges are sources of river pollution. Unfortunately, the amount of contaminants increases from year to year, as the treatment plants of the plants that discharge treated wastewater into the river need to be modernized. This is confirmed by long-term data where the exceedance of MACs of pollutants increases at the joint effluent discharge points of enterprises and downstream [10, 11].

Results and discussion.

In the water of r. Nur in the zone of influence of Temirtau industrial complex the content of copper from 2009 to 2016. Consistently exceeded maximum permissible concentrations at all observation points, reaching a maximum in 2012 and 2014: 5 MACs and 6.5 MACs respectively (fig. 2). Even at the points above the combined wastewater discharge, the copper content remained high. Only in 2017 on the II point 1 km above the combined discharge of wastewater JSC "Arcelor Mittal Temirtau" and CMF LLP "TEMK", as well as in 2018 at Point V Mill Dam the level of copper fell below the maximum permissible level. In 2018, the level of the mill dam fell below the maximum permissible level. Such a picture shows that r. Nura is polluted by oil regardless of the Temirtau industrial complex. The high oil content is determined by the natural xenobiotic profile along the river bed itself.

Zinc content in r. Nura showed (Fig. 3) dependence on the sampling point: lower values or within the MPC the zinc content in water was observed on I (Samarkand podhr, 0.5 km above the dam) and on IV paragraphs (r. Nura, 1 km below the combined discharge of wastewater of JSC "Arcelor Mittal Temirtau" and CMF LLP "TEMC"). That is, the zinc in the water is less up to the Temirtau industrial complex, as well as downstream. Moreover, the discharge of zinc into the water occurs immediately after the Samarkand reservoir, even without reaching the combined discharge of wastewater by enterprises. Dynamics of zinc content by years showed its high content in 2009 (up to 2.5 MAC), 2014 (up to 3.7 MAC), 2017 (2.4 MAC), 2018 (2.2 MAC) years.

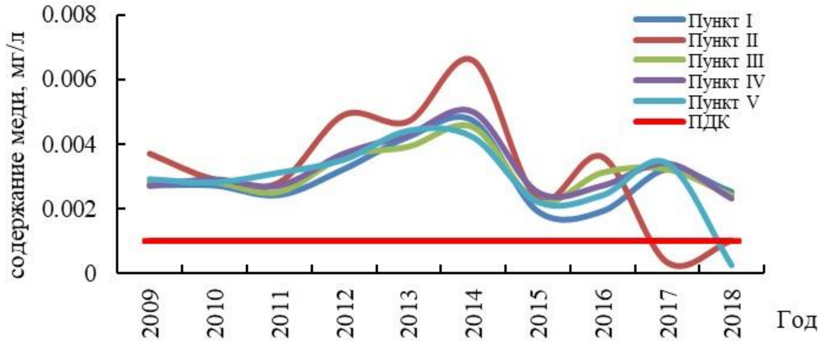

Figure 2. Copper content in the water of the Nura River in the zone of influence of the Temirtau industrial complex

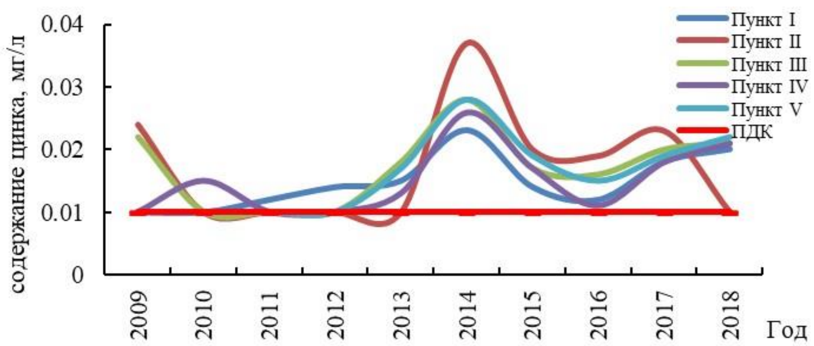

Figure 3. Zinc content in Nura River water in the Temirtau industrial zone

During the period under review from 2009 to 2018. The manganese content in the water r. Nura was reduced smoothly and gradually from a maximum of 2.6 MPC (2) to 0.7 MPC (5) (Fig. 4).

The sulphate distribution showed a complex picture both on the target and over time (Fig. 5): the highest sulphate contamination occurred in 2009 (3.4 MAC), 2012 (3.7 MAC), 2007 (3.5 MAC). The ratios of contamination over the sections are mostly traceable: water contains fewer sulphates at 1 and 5 sections.

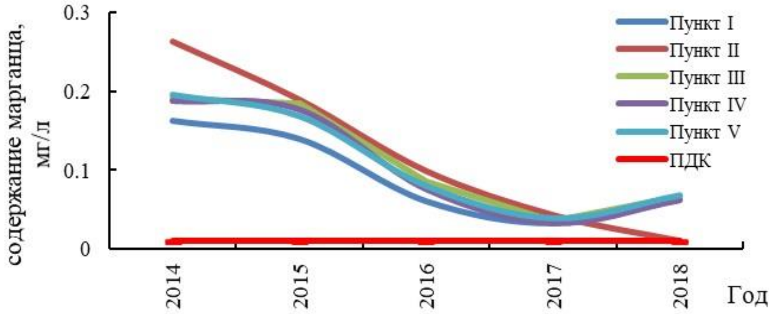

Figure 4. Manganese content in the water of the Nura River in the zone of influence of the Temirtau industrial complex

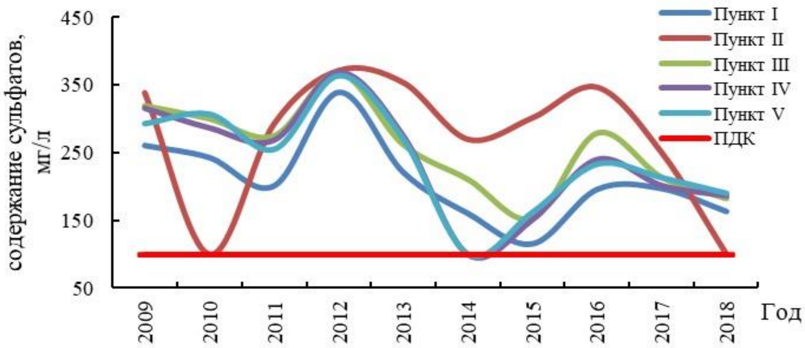

Figure 5. Sulphate content in Nura River water in the zone of influence of Temirtau industrial complex

The content of oil products in the studied sections of the river is chaotic and does not depend on the sampling points (fig. 6), but practically does not fall below the values of the maximum permissible concentration from 2009 to 2012.

Dissolved oxygen content in water is generally in accordance with the norm (fig. 7), but in all analysed years shows a fall on 2 alignment (1 km above the combined discharge of wastewater of JSC "Arcelor Mittal Temirtau" and CMF LLP "TEMK"), which is gradually leveled by 5 plots (r. Nura, Mill Dam). Similarly, the biological oxygen consumption of BOD3 in 2018 is drastically reduced by 2 cycles, which is evidence of the discharge of organic pollutants into water (Fig. 8).

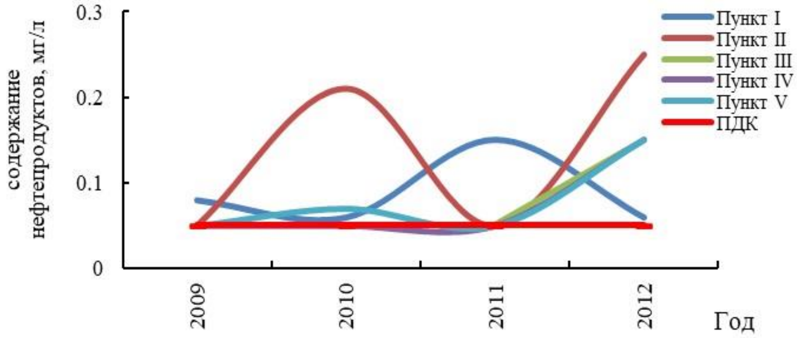

Figure 6. Content of petroleum products in water of p. Nur in the zone of influence of Temirtau industrial complex

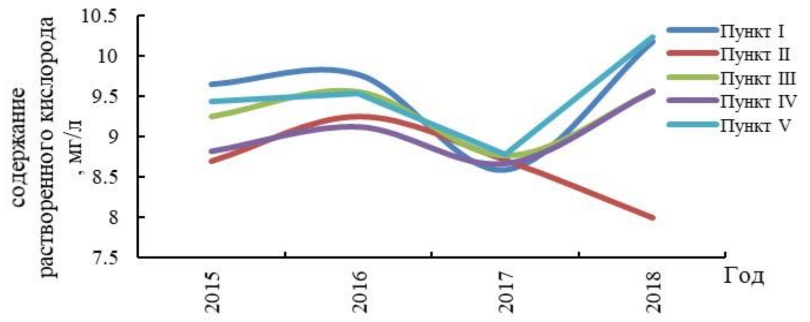

Figure 7. Dissolved oxygen content in water of p. Nur in the zone of influence of Temirtau industrial complex

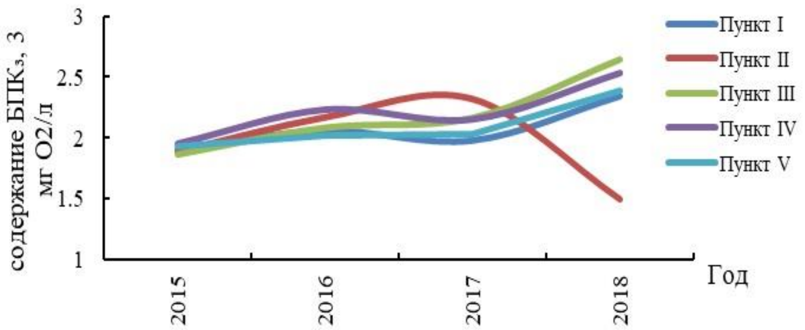

Figure 8. BOD3 content in water of p. Nur in the zone of influence of Temirtau industrial complex

In particular, the nitrogen content of nitrite was almost always higher at the 2nd point in all monitored points from 2009 to 2018 (fig. 9). Control 1 point (Samarkand reservoir) remained within the norm in all cases.

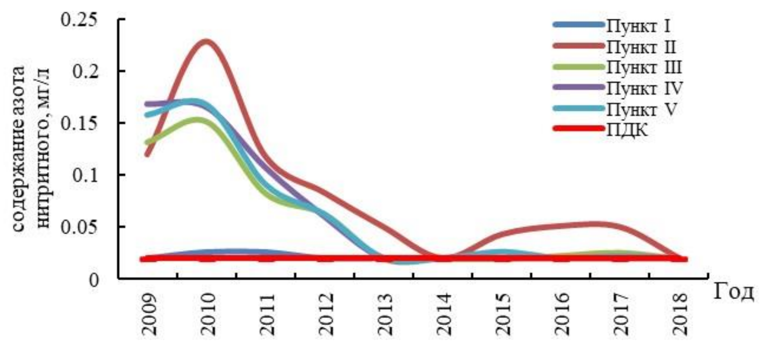

Figure 9. Nitrite content in water of p. Nur in the zone of influence of Temirtau industrial complex.

The mercury dissolved in water over 10 years is shown in Figure. 10. The graphs leave no doubt that it is the Temirtau facilities that pollute the river with mercury, as the upstream and upstream River I and River I contain mercury within the allowable limit for all the years studied. While at the remaining water sampling points, the mercury concentration increased many times over the years. The highest rates of mercury pollution were observed in 2010.2011 (up to 0.003 mg/dm^3) and 2014 (up to 0.0025 mg/dm^3).

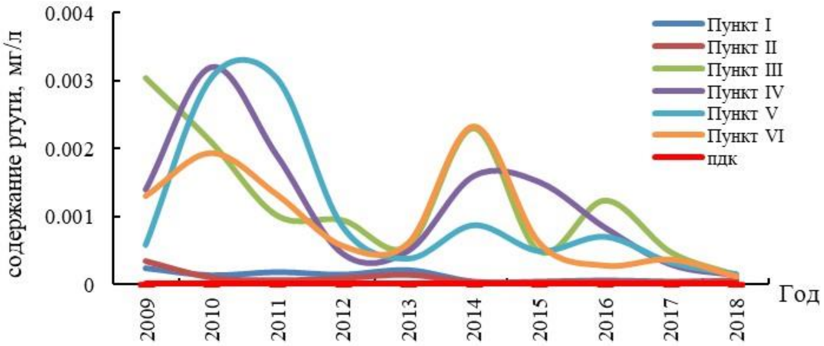

Figure 10. Mercury content in water of p. Nur in the zone of influence of Temirtau industrial complex.

There are large polluting plants ISPAT-KARMET and chemical plant «Carbide», which for most of its 30-th operation discharged mercury into water uncontrolled.

The main concentrates and carriers of mercury in r. Nura are technogenic silts. The total volume of technogenic silt in the Nura basin, located 25 km downstream of Temirtau, is estimated by tens of mln. tons [3, 4, 5].

Findings.

The natural regime of the Nura river has now been replaced by man-made water for a considerable length of the course, due to both the influence of the incoming wastewater and the intensive use of the river water for irrigation of agricultural land.

In r. Nura there is an excess of MAC of copper and oil products unrelated to emissions of Temirtau industrial complex.

B r. Nura maintains a relatively normal dissolved oxygen content in water, but 1 km above the combined discharge of wastewater JSC "Arcelor Mittal Temirtau" and CMF "TEMC" LLP emit organic pollutants, which reduces the BOD3 indicator. Technogenic effects on the Nur of the Temirtau industrial complex led to an increased content of pollutants in the water: mercury, zinc, sulphates, nitrogen nitrite, organic compounds. Of particular concern is the critical issue of mercury removal in r. Nura.

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