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Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

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ГЕОЛОГИЯ ЖӘНЕ ТЕХНИКАЛЫҚ ҒЫЛЫМДАР СЕРИЯСЫ

♦

СЕРИЯ ГЕОЛОГИИ И ТЕХНИЧЕСКИХ НАУК

♦

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Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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THEORY AND PRACTICE OF SELFPURIFICATION CAPACITIES OF NATURAL WATER IN KAZAKHSTAN

Abstract. The theoretical basis and practical about self-purification and self-cleaningcapacity of natural water sourcesin arid areas in Kazakhstan have been analyzed. It was foundout thatone of the unique properties of natural water is the self-purification capacity of water masses. Moreover, in the lakes and rivers of arid zones, those processes can be intensified because of the shallowness and intensive mixing of water. Those processeslead to oxygen saturation, turbidity, emergence of colloidal suspended solids,and solarradiation heating.Also,the role of various factors for how vegetation residuesin the mineralization process evolved biogenic organic matters is analyzed. It was explicitlynoted that the processes of degradation and mineralization of the leavescould progress at different speeds for different trees. Most of the time, the river water was enriched with easily oxidized organic substances and ammonium nitrogen.

The experiment methods helped to identify the self-purification capacity of the river Ulken Almaty tested river area with its ecotopes. Thus, such research provides the opportunity to determine whether rivers or other waterbodies need additional measures to enhance the effectiveness of natural water processes or to neutralize the pollution coming from the outside.

Keywords: self-purification, self-cleaning capacity of natural waters, degradation of organic matter, water resources conservation.

Aims and background. The process of self-purification in contaminated natural water sources is associated with a variety of naturalprocesses (hydrodynamic, chemical, microbiological and hydro biological)which result in the restoration of the original properties and composition of water in waterbodies (lakes, rivers, reservoirs, etc.) [1]. A large number of pollutants and specific (physical and geographical) conditions of water bodiescan depend onthe complex variety of valuable natural self-cleaningcapacities of water in water bodies. Mainly, natural self-cleaningspeed and direction can bemeasured through water pollutants' chemical properties, content and combinations. At the same time, dilution and mixing of sewage with natural water in water reservoirs can cause hydro biological and hydro chemical changes or substance transformation process, which in their turn identifyself-cleaning speed and directions. The latter plays a decisive role in self-cleaning processasphysical and chemical reactionsare closely related to biological or microbiological processes; however, it is unclear and sometimes difficult to acknowledge which flow is predominant[2].

The study of self-purification capacity (SC) of water bodies can be conducted differently: through design analysis (calculation of water pollutants' modification rates, their maximum permissible discharge, modeling, prediction) and full-scale research (laboratory experiments directly in the water body). The most rigorous data can be obtained using the second design if aquatic contamination and self-cleaning of waterprocesses inreservoirs are immediatelyexamined. SC research can be preferably started with collecting and analyzingexistingdata and reconnaissance surveys of the water body in order to clarify the characteristics and the sources of pollution.

There many factors that can affect SC negatively: someinclude the hydrological regime, the amount of suspended substances, pH amount, water temperature, bethel deposits, sedimentsand vegetation degradation impurities. The last factor is of great value because putrescible and other biogenic substances in water bodies or in water courses are ensued from soil and bethel deposits.In turn, theyare formed with decomposition of tree and shrub vegetation, higher aquatic plants, terrestrial natural drainage area plants, phytoplankton, as well as atmospheric precipitates, coastal erosion and other factors.Estimating the effects of the factors on hydro chemical regime and water quality is complicated; however, they are not onlyessential in expertise and in development processes, they are also valuable for further modeling and forecasting of the components for planned and existing water reservoirs and water passages.

Some information has been accumulated about the rate of decomposition of certain types of higher aquatic vegetation in lakes and reservoirs in Russia [3-5] in Ukraine [6], in the countries far away [7, 8]. In Bosnia and Herzegovinathe results of the physic-chemical characteristics of the ground water has been documented [9]. In Kazakhstan, the self-purification capacity ofthe K. Satpayev channel and its reservoirs have been studied (1980-1986.) [10]. According to the research results, the water from the channel and its reservoirs annually form1079 and 33 tons of organic carbon, and 49,329 tons of mineral nitrogen and phosphorusdue to the degraded and mineralized aquatic vegetation and phytoplankton.

A long-term laboratory research study contributed to the significant results [11-13]. For instance,data on the absorption capacity of natural and chemically pure substances and the influence of the absorption process on natural purification capacity of waterbodiesand reservoirs have been obtained in the aridareas.

Regarding indicators of river water quality affect on water availability, the seasonal and daily dynamics of the inside reservoir processes are associated with the activities of the physicochemical, hydrological and biological factors.Mostly snow-supply water creates low water salinity during the flood period. For example, the Irtysh River water salinity increases from 0.5-0.8 g/l in the spring, to 1-3 g/l in the summer and increases in the winter period [11].

According to absorptive capacity, sorbents(chemically pure calcium and magnesium carbonates, orthosilicates of calcium and magnesium, calcium phosphate, calcium sulfate, aluminum hydroxide and iron oxide, silicon (IV), natural minerals, zeolites and silica gel)will captureions Mn^{2+}at a concentration of 50 to 500 mkg/l in the sulfate type(for example in the water bodies of Lake Balkhash, Lake Alakol, Lake Sasykkol) solution. These elements which are arranged in sequence at an average value ofadsorption exchange capacity (mM-eq./g.10^{-3}): SiO_2 (4,65); $Al(OH)_3$ (4,36); $Ca_3(PO_4)_2$ (4,12); $CaCO_3$(3,99); $MgCO_3$ (3,96); $CaSO_4$ (3,52); $Fe(OH)_3$ (3,36); $MgSiO_3$ (3,27); $CaSiO_3$ (0,73) respectively.

It was observed that in Balkhash, water heavy metals decreased when the above listed mineral sorbents were added into it. It has been already countedthat sulfatewater masses would be purified to the maximum permissible concentration from manganese ions [12] to 78% within a month. Lake Balkhash's sediments and clay also sinks metal ions: mainly clay absorbs ions Mn^{2+}, Zn^{2+}, Cu^{2+} and Cd^{2+} during the first four hours of their contact, whereas the adsorption of silt continues for between 10 to 15 days. Benthic sedimentabsorbs manganese (95%), cadmium (89%) then zinc (85%) and copper (77%) much better. Higher concentration of metal ions and anions of weak and strong mineral acids and organic acids may lead to precipitation of salts in technical water systems of Power Plants, especially in systems of cooling of condenser turbines in cooling reservoir [13].

The study allowed the authors to conclude that Balkhash water was cleaned from metals (Mn, Cu, Zn) and phosphate compounds that accumulated in silty mud and in the sedimentdue to the intensivesedimentation of calcium and magnesium carbonates and other precipitatedmetal ions and non- metals. However, activesolar radiationand heating to the intensive agitated water couldcreate a reverse reaction: it means that those accumulated metals in benthic sediment could emerge into the water again. Thus, all processes in the waterbody and the biological matter can continuously occur throughout its life [12].

The role of various factors in the mineralization process of vegetation residueswhen they evolve biogenicorganic matters into the water is still debatable. The diffusion of organic matters occurs under the influence of microorganisms. In this regard, self-purification from organic pollution is primarily determined by the same factors as the microbial and self-purification of water bodies. A study of the intensity of organic matter degradation will more fully allow the understanding of the characterization of the self-cleaning capacity of water bodies, the turnover of nutrients and organic matteras well as the qualitative state of natural water. In addition, such studies are very important in the development of a number of water resources conservation measures.

Experimental. *Material and research methods.* A significant number of higher plants,including leaves of trees growing along the river bed, can fall into rivers and in the catchment area. This can occur through flushing itssurfaceby melt and rain waters as well as by Aeolian.It is known that aquatic flora helps the water to self-purify, enriching it with oxygen: this creates favorable conditions for existing aquatic organisms.However, abscission process can cause a number of negative consequences: disruption of the entire aquatic ecosystem, deterioration of water quality, weeding river channels and basin areasof water bodies (atrophy), etc. Previous research results (mentioned above) enabled us to conduct special studies where we evaluated the impact of organic matterdescendant (leaves) on water quality of small rivers of the Northern Hillslopes of Ili Alatau which is connected to the Ili-Balkhash basin.

The authors calculated the mass of tree leaves that fell during abscission in a direction along the entire length (60 km) of the Ulken Almaty River to the mouth of the Kaskelen River which is the tributary of the Ili River (table 1).

Table 1 – The average values of the mass of dry leaves of trees along the coastal strip of the Ulken River, Almaty

Tested river areas	Birch		Elm	
	average number of leaves in the head, thous. pcs.	phytomass, ton of dry weight	average number of leaves in the head, thous. pcs.	phytomass, ton of dry weight
Upstream (approximately 20 kilometers of mountain and submountain parts)	107±7	11,6	124±5	7,9
Downstream (aprox.60 km.)	61±3	19,8	84±3	16,1
Overall		31,4		24,0

Note: The trees were aged between 5 to 35 years; on average, there are 200 trees the banks of the river at a distance of 1 km; coastline stands 10 m width on both sides of the river were taken for this investigation.

For the experiment the leaves ofbirch *Betula*were chosen – its origin is *Betulaceae* birch family;and the leaves of silver birchare from *Betula pendula*family. Also, elm leaves (elm-tree) of *Ulmus* family i.e. *Ulmuceae* and leaves of the ordinary elm, *Ulmus laevis Pal*were examined. For the experiment, the leaves have been assigned atthe Department of Biodiversity and Biological resources of the Faculty of Biology and Biotechnology in the Al-Farabi Kazakh National University.

First of all, dust and soot wasthoroughly washed from the leaves in the running water and then dried. Then, we determined 10 leaves' air-dry weight from each tree: birch weight was 0.27 g. andelm consisted of 0.16 g. Based on the observations, we assumed that about 15 % of the leaf litter falls into the river bed.

It was established that the total volume of phytomass on the riverside width of about 10 meters along the river-bed Ulken Almaty consisted ofmore than 55 tons: 8 tons of which fell into the water body andthen began the decompounding process.

The data clearly indicated that the riverwas complemented with organic matter and withnutrients. During the experiment, fallen elm and birch leaves were placedin sterilized glass containers holding 20 liters of water. For protection against pollution and the preservation of gas exchange,the glass containers were covered with air sealed cotton- gauze fabric. The water containers with leaveswere periodically agitated. Samples of leaves in equal amounts were collectedin the upstream and downstream parts of the river. Leaves were ground and placed on the bottom of the container and filled with river water. The quantity of leaves was equivalent to 0.5 g of dry substance per 1 liter of river water. Standing water level was supported with water additions to the river Ulken Almaty after sufficient quantities of water samples were taken to conduct the experiment. The research experimentlasted 455 daysand the temperature of the testwater ranged from15^0 to 23^0 C. From the water samples, we identified the content of dissolved oxygen in water, carbon dioxide, pH, nitrogen compounds in the form of nitrite, nitrate, ammonium, easily oxidized organic matter (OM) by permanganate oxidation [14] with the help of generally accepted methods in hydrochemistry.

Results and discussion. *Phytochemical study of elm and birch leaves* [15-16]. Elm is a tree with a dense crown. Many species of elm are used in medicine as an agent for anti-cancer, diuretic, astringent, laxative, wound-healing, analgesic and other treatments.

Evaluations of the qualitative composition of the main groups of biologically active compounds were carried out on the basis of specific qualitative reactions. Thesultsrevealed 6 groups of biologically active substances (carbohydrates, polyphenols, amino and phenolic acids, tannins, and flavonoids).

According to the generally accepted methods and pharmacopeia of the State Pharmacopoeia of the Republic of Kazakhstan, the leaves of that type of elm were determined to be indicators of quality of high quality materials: with a moisture content of 7.52 %, with common ash of 16.63 % , and with insoluble ash at 10% and hydrochloric acid at 6.93 %.

There are 6 general and about 150 species of birch family (Betulaceae S.F. Gray) in the world. They are distributed mostly in the moderate, non-tropical areas of the northern hemisphere. Also, 40 speciesoccur in the flora of the CIS, but only 2 genera and 16 species grow in Kazakhstan territories [17-18].

Birch, *Betula pendula Roth,*is known as a source of aspic oil, saponin, flavonoids, vitamins, resins and other biologically active substances. That is why many species of birch are used in official and folk medicine as antimicrobial and antiphlogistic agents, and for anti-sclerotic, diuretic, antiscorbutic, anti-inflammatory, regenerating, antioxidant and other purposes.

The above mentioned birch leaves were identified ashigh qualitymaterial indicators with moisture (7.45 %), with common ash (14.58 %) and with insoluble ash in 10% and with hydrochloric acid (8.33 %).

Within the three months of the experiment, temperatures ranged from 18 to 21^0 C in the containers. The amount of water pH decreased abruptly within 2 hours after the water contacted the leaves: the level of water was reduced in both the birch and elm containers. The results show that in the birch leaves' containers, the level of the pH lessened for to 0.60 units and in the elm its concentration became less for 0.29 units. In the containers with birch leaves, the pH level varied from 7.65 after 2 hours of contact with leaves and the level changed into 7.52 after 3 months of observation. The pH level in containers with elm leaves changed from 7.96 to 7.48 respectively. The initial water had a pH value equal to 8.25. The smallest decrease in pH values wasobserved in the experiment with birch leaves (the pH 0.13 units). In other words, some aquatic acidification took place when organic and mineral acids passed from the leaves into the waterwhile the experimenting leaves decomposed and mineralization process began in the river water.

As well, nitrogen compounds formed in the water throughout the observation period. Most of the water was enriched with ammonium nitrogen in the first 10 hours of contact of the water and leaves.If the original river water contained ammonia nitrogen 0.031 mgN/l: after 2 hours the water with birch leaves contained 0.529, and the elm container had 0.078 mgN/l of ammonia nitrogen. The concentration of the latter gradually increased respectively , to 0,622 ; 0.545 mgN/l after 10 hours of contact. After 3 months of observation, the ammonium nitrogen content became 0.233 (birch leaves) and 0.564 mgN/l (elm leaf), exceeding the original river water ammonium nitrogen by 7.5 and 18.8 times respectively. It should be noted that the change in the concentration of ammonia nitrogen was monitored. The water temperature, lighting, the size of crushed leaves and stirring had a significant influence on the leaves in the laboratory.

Nitrite ions are highly volatile components of the chemical composition of natural waters; however, we found out the following: typically, the presence of nitrite in water indicates fresh water pollution with nitrogen compounds. After 2 weeks ofobservation, Birch leaves produced maximum nitrite nitrogen (0,106 mgN/l). In the containers, its concentration increased 5.9 times in comparison to the original river-water concentration. The elm leaf water had a maximum nitrite nitrogen levelafter 2 weeks of observation (0,091 mgN/l). Therefore, in the laboratory containers, its concentration moved up5.1 times in comparison with the river-water. At the end of the third month of observation, in the testing water, thenitrite nitrogen level was decreased by 0.003 - 0.007 mgN/l in comparison to the original river water. However, the decomposition and mineralization of leaves were progressing.

Usually nitrate nitrogen concentration does not often exist longer in natural water. For example, if the concentration of nitrate nitrogen was 0,124 mgN/lin the river water, thenafter 2 hours of its contact with only elm leaves, the level of nitrate nitrogen increased to 0.311 mgN/l . However, in further stages of the experiment, such amount of nitrate concentrations were not detected. This can show us that the proceeding denitrification process (ammonation) actively takes place in nature.

Naturally, the water is usually enriched with easily oxidable organic matters. So, in the birch leaves' container, permanganate oxidation (PO) value increased to 4.2: andin the original river, the water PO value increased to 14.2. Also, theelm leaves' PO value moved up 16.8 mgO/l after two hours contact in the container. The birch leaves reached the maximum amount of permanganate oxidation value(25.5 mgO/l) in the container after 1 day of contact. However, elm leaves' maximum PO 23,1 mgO/l was reached after 1 week of contact in the experiment. By the end of the 3rd month of the observation, the PO values varied between8,0 to 11,8 mgO/l, so they were higher than the original PO valueby 1.9-2.8 times.

Data collected between the 4 to 15 month time period is shown in figures 1, 2, table 2.

During the experiment, the temperature in the containers varied from 18 to 19^{o} C. The level of pH slowly increased in the container water. The amount of pH increased to 8.82 in the container during the12 months it was in contact with birch leaves. Similarly, the pH water level in the container with elm leaves increased to 8.87 units. From the beginning of the 12th month till the 15th month, the amount of the container pH with birch leaves varied from 7.53 to 8.93. In the elm container, it ranged from7.41 to 8.95 (figure 1). In fact, the original level of pH in the containers corresponded to 8.25. Thus, during the experiment we monitored how the pH amount with elm leaves had decreased more (0,02 units of pH) in comparison to the birch leaves (0,02 units ofpH). Thus, the gradual expansion of pH amount from7.50 to 8.90 in the containers during the study was the result of the leaves' destruction and mineralization. In other words, the testing solution was alkalinized because the organic and mineral substances of the leavespassed into the water.

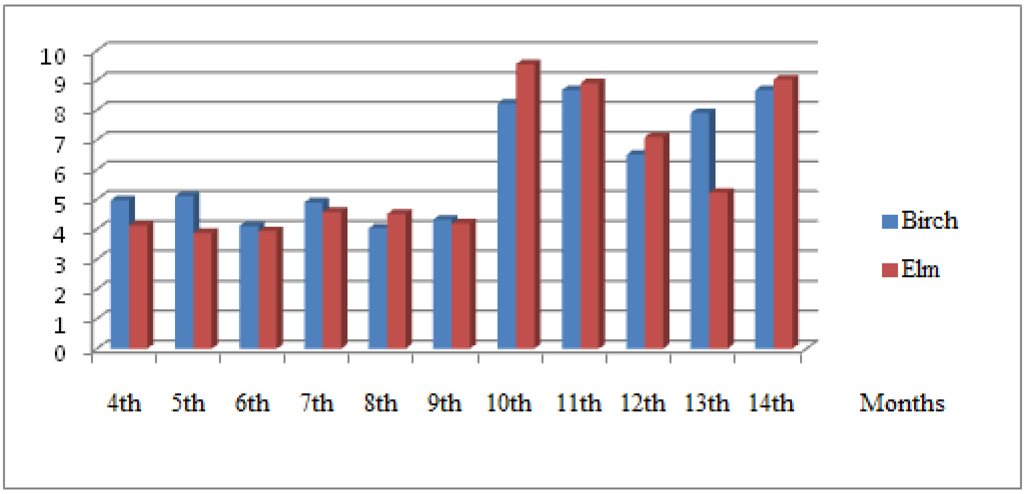

Figure 1 – Changes in pH values in the experiments with the birch and elm leaves during the 4th to15th months

The dissolved oxygen level abruptly changed for 10 months starting from the 4th till the 14 month in the containers with both the birch and elm leaves. For example, between the4thto the 9th month, no changes in the experimenting water were noticed; however, by the end of the 10th month the concentration of oxygen began increasing gradually. In the elm leaves' container, its concentration ranged from 4.97 to 9.54 mg/l and in the birch leaves it fluctuated from 6.22 to 8.43 mg/l (figure 2). More oxygen concentration allowed the leaves to decompose more quickly in the water. That is why by the end of the observation; the dissolved oxygen level was almost the same in both containers.

As it is known, easily oxidized organic substances enrich water in most cases. Thus, in the birch leaves containers, the permanganate oxidation value rose from 4.2 and in the river water, the atomic oxygen level increased to8.0 mg/l after 14 months of leaf interference. The elm leaves' atomic oxygen level increased to 2.55 mg/l in the container. The maximum value of PO with the birch leaves in the experiment (8.0 mgO/l) was reached. By the end of the 14th month of the observation, the PO values ranged from 0.32 to 12.2 mgO/l exceeding the original value of 2 to 2,8 times (table 2).

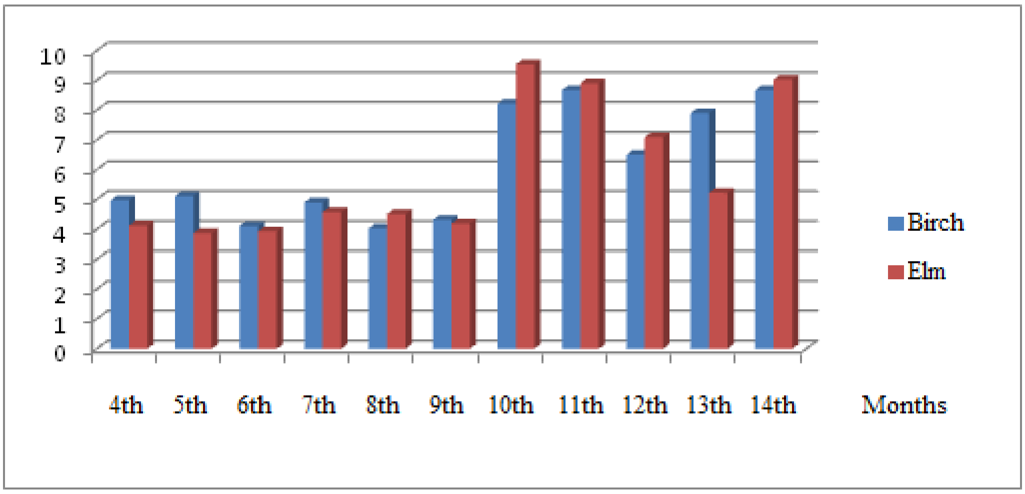

Figure 2 - Variation of dissolved oxygen level ofboth birch and elmleaves between the 4 and14 monthsof the experiment

Table 2 – Dynamics of the nitrogen compounds and the amount of PO of birch leaves (b) and elm (e)

№ experiment, type of leaves	Exposure/contact time month	Ammonia-N, mgN/l	Nitrite nitrogen, mgN/l	Nitrate nitrogen, mgN/l	POmgO/l
1 – b	4 months	0,078	0,012	1,892	5,31
2 – e	4months	0,062	0,091	0,757	10,68
1 – b	5 months	0,078	0,009	0,112	4,16
2 – e	5 months	0,078	0,006	0,344	9,92
1 – b	6 months	0,078	0,003	0,068	6,80
2 – e	6 months	0,062	0,009	0,584	11,84
1 – b	7 months	0,311	0,009	0	1,85
2 – e	7 months	0,233	0,009	0	4,54
1 – b	8 months	0,078	0,003	0	5,31
2 – e	8 months	0,070	0,006	0	9,92
1 – b	9 months	0,070	0,009	0	8,00
2 – e	9 months	0,079	0,003	0	9,92
1 – b	10 months	0,156	0,015	0	4,20
2 – e	10 months	0,087	0,009	0,013	9,40
1 – b	11 months	0,110	0,009	0	9,28
2 – e	11 months	0,078	0,006	0,013	15,22
1 – b	12 months	0,110	0,005	0	9,50
2 – e	12 months	0,124	0,008	0	12,20
1 – b	13 months	0,156	0,018	0	7,20
2 – e	13 months	0,153	0,091	0	12,00
1 – b	14 months	0,233	0,003	0	8,00
2 - e	14 months	0,305	0,006	0	8,19

Nitrogen compounds flew into the water throughout the observation period. Mostly, water was enriched with ammonium nitrogen after 4 months of water and leaf contact. If the original river water contained ammonia nitrogen mgN/l 0.031, in the experiment after 4 months of the birch leaves in the container, the water contained 0,078 mgN/l of ammonia nitrogen; and the elm leaves container had 0,062mgN/l of ammonia nitrogen. The concentration of the latter gradually increased, to 0.078; and to 0.233 mgN/l respectively after 4 months of contact of leaves with the experimental water.

After 14 months of observation, the ammonia nitrogen content became 0.233 (birch leaves) and 0,305 mgN/l (elm leaf) which exceeded the initial concentration in the river water7.5 and 9.8 fold respectively (table 2). It should be noted that the change in the concentration of ammonia nitrogen also occurred abruptly. The process of destruction of the leaves in the laboratory has a significant influence of water temperature, lighting, the size of crushed leaves, mixing the contents of dissolved gases, micro-organisms and other factors.

In the elm leaves container, the nitrite nitrogen level became mostly high (0.091 mgN/l) within the first 4 month duration, while its level inthe birch leaves containers was 0.012 mgN/l. During the 14 months of the observation, we could point out that the leaves' degradation and mineralization processes were still in progress. But the level of nitrite nitrogen reduced noticeably in the experiment containers to 0,015 - 0,012 mgN/l rather than the 0.018 mgN/l reduction which occurred in the original river water had.

As usual, nitrate nitrogen is hardly detectable in natural water, and that moment its level was 0,124 mgN/l in the river water but its concentration raised when the river water was mixed with elm leaves in the testing containers for 6 months (0.46 mgN/l.) In the following months, nitrate ions were not found and it indicates that the natural flow of ammonification process had taken place.

Self-cleaning capacity (SC) of river water. In reality SC of values in relation to "water - leaves" (except for nitrate and nitrite) can negatively affect the other parameters of the water quality i.e. the water is not self-cleaning: it is becoming polluted by mineral nitrogen in the form of ammonium ions and easily oxidized organic substances. Most of the water is rapidly polluted with ammonium nitrogen as a result of the regular ammonization process in the water. In addition, the water will be severely depleted from the large amount of dissolved oxygen. Also, the value of self-purification capacityis 5.12% for elm leave sand 0.93% for birch leaves.

Conclusions. It was explicitly seen that decomposition and mineralization of tree leaves had fallen leaves with various speed for different components. Most of all, the river-water was easily enriched with oxidized organic substances and ammonium nitrogen.

The experiment methods helped to identify the self-purification capacity of the river Ulken Almaty tested river area with its ecotopes. Thus, such research provides the opportunity to determine whether rivers or other waterbodies need additional measures to enhance the effectiveness of natural water processes or to neutralize the pollution coming from the outside.

REFERENCES

[1] Spravochnik po gidrohimii. Pod red. A.M. Nikanorova (**1989**). L.: Gidrometeoizdat. ISBN 5-286-00143-2

[2] Romanova S., Preisner L. (**2011**) The theoretical basses and methodology of reseaches of antropogenic transformation of hydrochemical regime of reservoirs of arid zones – Case of Kazakhstan // Polish Journal of Environmental Studies. Vol. 20, N 4. A:277-281. DOI: 10.15244/pjoes/70627

[3] Margolina G.L. (**1966**) Processy samoochishhenija vody v sibirskih vodohranilishhah // V kn.: Producirovanie i krugovorot organicheskogo veshhestva vo vnutrennih vodoemah. M.-L.: Nauka. P. 200-203 (In Russian)

[4] Tarabrina T.I., Bolshov A.A., Drizo E.A.(**1987**) Destrukcija organicheskogo veshhestva v delte Urala // V kn.: Izuchenie processov formirovanija himicheskogo sostava prirodnyh vod v uslovijah antropogennogo vozdejstvija. Chast 1. L.: Gidrometeoizdat. P. 163-164 (In Russian)

[5] Semenov I.V. (**1972**) Nekotorye voprosy izuchenija zagrjaznennosti i samoochishhenija rek bassejna Tereka: Avtoref. dis. ... kand. geogr. nauk. Rostov-na-Donu. (In Russian)

[6] Majstrenko Ju.G., Denisova A.I. (**1968**) Drevesnaja rastitelnost kak istochnik biogennyh i organicheskih veshhestv v prirodnyh vodoemov [Gidrobiologicheskij zhurnal] 4(5):12-19 (In Russian)

[7] Gunf G.G. (**1973**) Ecological stability in a Challow eguatorial lake (Lake George, Uganda) // Proc. R. Soc. Lond. B., 18:321-346

[8] Hupp E.R. (**1963**) Plancton and its ralationship to chemical factors and environment in white River Canal. Indianapolis // Butler Univ. Bot. Stud. 6: 123-135.

[9] Nogic M., Sciban M., Savic M., Jolovic B. (**2014**) Water quality at the source in the municipality Laktasi, Bosnia and Herzegovina // Oxidation communications. 37(4): 1065-1073. ISSN: 0209-4541

[10] Amirgaliev N.A. (**1998**) Iskusstvennye vodnye obekty Severnogo i Centralnogo Kazahstana [gidrohimija i kachestvo vody]. Almaty: NIC «Bastau». ISBN 9965-413-33-9

[11] Kamkin V., Beisembayeva M., Mazbayev O., Bazarbekov K. (**2016**) Effect of Environmental Water Release on the State of Flora and Vegetation of the Steppe Plain Segment of the Irtysh River Floodplain // Oxidation Communications. 39 (1-I): 348-357. ISSN: 0209-4541

[12] Kazangapova N., Romanova S. Lake Balkhash – a drain less lake // Meyer B.C. & L.Lundy (Eds.). (**2014**) // Integrated Water Cycle Management in Kazakhstan (textbook). Almaty: Qazag university. P. 189-195. ISBN 978-601-04-0900-2

[13] Romanova S.M., Ponomarenko O.I., Kazangapova N.B., Matveyeva I.V., Nazarkulova Sh N. (**2015**). The impact of fluctuations of temperature on hydrochemistry of cooling reservoir // International Multidisciplinary Scientific Geoconf. Surveying Geology and Mining Ecology Management, SGEM 1 (3). Albena, Bulgaria. P. 655-662.

[14] Rukovodstvo po himicheskomu analizu poverhnostnyh vod sushi / Pod red. A. D. Semenova (**1997**). L.: Gidrometeoizdat.

[15] Kadlec R.H., Knight R.L. (**1996**). Treatment Wetlands, Lewis Publishers // Boca Raton, FL.... 17: 948.

[16] Jekologija goroda: Ucheb. posobie / Pod red. V. V. Denisova (**2008**). M.: IKC «MarT». ISBN 978-5-241-00900-5

[17] Abdulina S.A. (**1999**) Spisok sosudistyh rastenij Kazahstana. Almaty. ISBN 5-7691-1788-5

[18] Bajtullin I.O. (**1989**) Jekologicheskie osnovy introdukcii rastenij // [Izvestija AN KazSSR, serija biolog.] 9:3-15 (In Russian)

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ТЕОРИЯ И ПРАКТИКА САМООЧИЩАЮЩЕЙ СПОСОБНОСТИ ПРИРОДНЫХ ВОД КАЗАХСТАНА

Аннотация. Рассмотрены теоретические основы и практические результаты по исследованию процессов самоочищения и самоочищающей способности природных вод аридных зон (на примере природных вод Казахстана). Установлено, что природные воды обладают одним из уникальных свойств – способностью к самоочищению водных масс. Причем, в водоемах и водотоках аридных зон эти процессы усиливаются за счет их мелководности, интенсивного перемешивания воды, способствующих взмучиванию, насыщению кислородом и коллоидно-взвешенными веществами, прогреваемости и активному воздействию солнечной радиации. Освещен вопрос роли различных факторов на процесс выделения в речную воду органических и биогенных веществ при минерализации остатков растительности. Отмечены явно выраженные процессы деструкции и минерализации листьев деревьев, протекающие с неодинаковой скоростью для разных компонентов. Больше всего речная вода (на примере реки Улькен Алматы) обогащается легко окисляющимися органическими веществами и аммонийным азотом.

Представленная методика расчета способности малой реки Улькен Алматы к самоочищению с учетом природной составляющей водных экотопов, позволит более достоверно определить самоочищение реки на определенном отрезке. Это дает возможность определить, необходимы ли дополнительные мероприятия по усилению эффективности природных процессов, или же река в состоянии сама нейтрализовать загрязнения, поступающие с водосборной площади.

Ключевые слова: самоочищение, самоочищающая способность природных вод, деструкция органического вещества, охрана водных ресурсов.

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ҚАЗАҚТАННЫҢ ТАБИҒИ СУЛАРЫН ӨЗДІГІНЕН ТАЗАЛАНУЫНЫҢ ТЕОРИЯСЫ МЕН ПРАКТИКАСЫ

Аннотация. Қуаңшылық аймақтардағы табиғи суларды тазалау мен өздігінен тазаланудың (зерттеу нысаны ретінде Қазақстанның табиғи сулары) практикалық зерттеулері мен теориялық негіздері қарастырылды. Табиғи сулардың өздігінен тазалануға қабілетті, керемет бір қасиеттері – су массасын ретке келтіріп отыратыны анықталды. Қуаңшылық аймақтардағы судың тазаланып басқа сулардың қосылып отыруының арқасында, аз мөлшерде болса да оттегімен және коллоидтық қоспаларменараласуы, күн сәулесінің радиациясы арқылы судың қызуы – судың бесленділік қабілеттілігін арттырады. Судағы әртүрлі факторлардың әсерінен өзен суларынан органикалық және биогендік заттардың бөлінуі, өсімдік қалдықтары арқылы минерализациялану процесстері қарастырылып олардың атқаратын рөлдері қандай деген сұрақтардың шешімі табылды. Ағаш жапырақтары мен әртүрлі жылдамдықпен ағатын су арналарының деструкциялық процесстерге әсері нақты белгілі болды. Көбінесе өзен суларының құрамында (мәселен, Үлкен Алматы өзен суы) тез тотығатын органикалық заттар мен аммоний азот қоспалары бар екені анықтылды. Белгілі бір аймақта кіші өзен сулары соның ішінде Үлкен Алматы өзен суының құрамын өздігінен тазалау әдістері есептеліп, олардың құрамындағы қоспалардың мөлшері анықталды. Су қоймаларының өздігінен тазалану жолдары анықталып, қосымша амалдар жасау нәтижесінде табиғи процесстердің эффективтілігін айқындаудың мүмкіндіктері зерттелді.

Түйін сөздер: өздігінен тазалану, табиғи сулардың өздігінен тазалану мүмкіндіктері, органикалық заттардың деструкциясы, табиғи су ресурстарын қорғау.

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