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CHEMICAL ASSESSMENT TESTS FOR WATERBALANCED TECHNOLOGIST

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It was investigated the influence of the anthropogenic stress on the physical chemistry parameters of the natural water. There was found a correlation of water redox -potential with a current's speed and self-clearing ability of water. The influence of mineral components on water oxidizing activity is experimentally confirmed. It is determined that self-clearing ability of natural water is low in violation of the waterbalance.
Keywords: redox activity**,** oxidizing activity, mineralization, anthropogenic stress, biogenic remains, current's speed, waterbalance.

INTRODUCTION

The problem of preservation of quality of water objects is the actual worldwide problem which is far from solution, and the Crimean region isn't an exception. Influenced by anthropogenic activity, superficial water objects began to serve as final parts of drain accumulation of polluting substances. Signs of extreme degrees of ecological trouble are revealed for the Crimean rivers, dry riverbeds, lakes and bulk reservoirs, though in domestic and world practice there are methods of protection of water objects from pollution and preservation of their biocenotic systems [1], such as: removal and shielding of ground deposits, water drainage from hypolimnion and change of conditions in habitat hydrocoles. However, all these technologies are directed on the intensification of processes of the deeutrophication caused by natural ecological stratification. Under conditions of an anthropogenic stress (availability of pesticides, surfactants, heavy metals, etc.) their application is ineffective without application of additional physical and chemical processing and the methodologies which are based on the theory of formation of habitat-forming complexes within river pools [2]. For practical use of such ecologically balanced water security ways and technologies it is necessary to minimize quantity of physical and chemical rates of quality of water and methods of their assessment for acceleration of reaction and expansion of territorial mobility. It is necessary for introduction of these technologies in places which are far from stationary laboratories. Therefore the main objective of this research was the choice of integrated chemical rates of quality of water for an express assessment of intrabassin processes.

MATERIALS AND METHODS

The water in river Kurtsi, the left tributary of Salgir, that is flowing into Simferopol reservoir was chosen as the test nature object. The research object was the water in this stream. The water sample was taken on the route showed on the map (fig 1). The rout's choice was made with taking in account the presence of anthropogenic pollution sources in the places of sample taking (spontaneous dumbs, farm drains, land draining etc.) and availability of natural cleaning factors (reed mace growth, storage basins, flow).

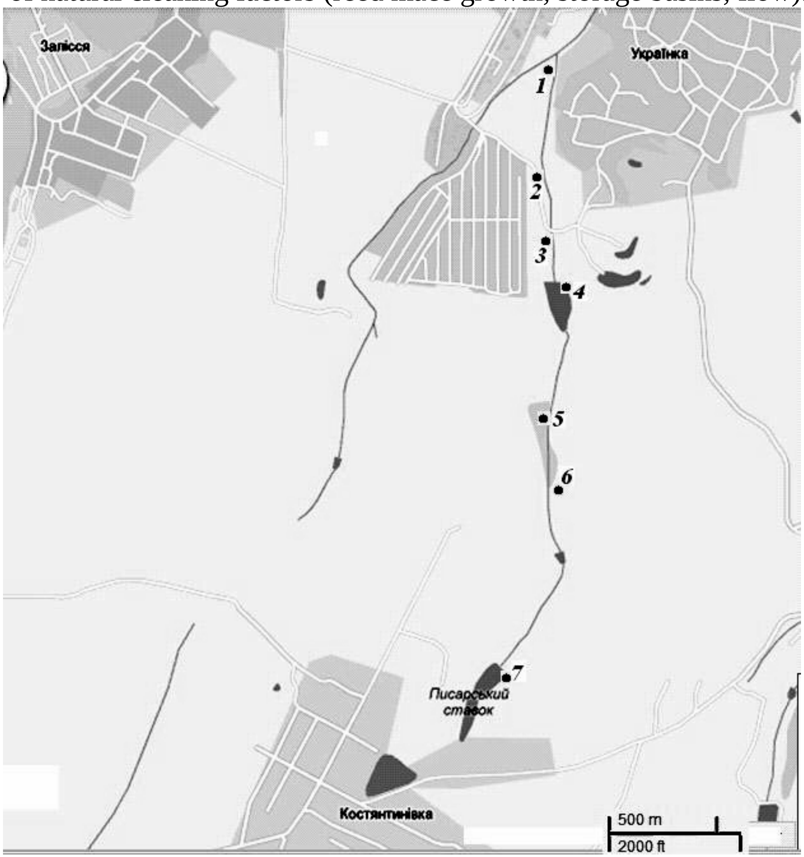

Fig 1. The map of sampling

The main research methods were direct potentiometry methods which were used by pH and Eh – measurements. pH-rates were measured by the ionometer with use of glass electrode and secondary silver chloride electrode. Measurement error made ±1,2%. Eh-rates were also measured by the ionometer "with use of platinum electrode and silver chloride secondary electrode. Measurement error made ±1,5%. The deoxidizers' amount in the water was estimated according to the dichromate oxidizability using the following method: there were added to the taken water aliquot 5 ml of 0,25n $K_2Cr_2O_7$solution, 1g of mercuric sulfate $HgSO_4$ (for Cl ions' banding) and 0,4 g of silver sulfate (catalyst). Then 3 ml of the concentrated sulphuric acid and 5 ml concentrated H_3PO_4 were added. The prepared sample was boiled in the thermostable flask with the backflow condenser within

3 hours. After cooling the mixture was titrated using the microburet with 0,25 n of Mohr' salt solution in the presence of N-phenylanthranylic acid. The dichromate value (X) was calculated according to:

$X = (V_1 – V_2)·N·8·100/V$ mg/l O_2

V_1 – the volume of Mohrs salt, expended for the titration of 5 ml 0,25 n solution $K_2Cr_2O_7$ (in the indirect run). V_2 the volume of Mohrs salt, expended for the aliquot's titration, in ml; N is the normalcy of Mohr's salt solution; V is the researched water volume taken for measurement, in ml. The general water mineralization was estimated according to the dry residue using the weight method with measurement error ±0,05%.

RESULTS AND DISCUSSION

The dependence COD of development pressure in the sampling of natural pond was analytically confirmed. Values of chemical consumption of oxygen show high rates in third sample and sample № 6. Increase of COD value of sample 3 and 6 in comparison with other samples is connected with presence of a large number of the biogenic remains at the bottom of a stream in this area. Sample 3 was taken in the channel after the fishing pond which stands rather high technogenic influence since the pond is used for commercial purposes. And the value of COD in pond water doesn't differ considerably from one in the channel sedimentation. Sample № 6 was taken in a reservoir which stands stressful influence resulting from water dumping from hog farm (fig. 2).

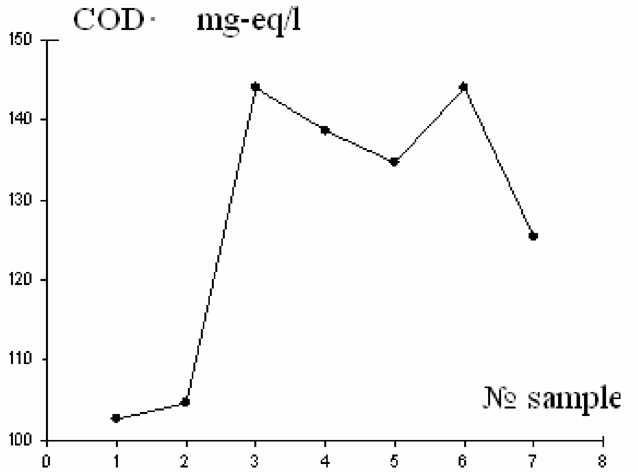

Fig. 2. Correspondence between change of COD of water and sampling locations

The obtained data of COD values correlate with results of redox measurement (Eh-potential) in the selected water samples. But in the samples № 1–3 the data dependence has an antibate character. In the samples of № 4–7 it has symbate one (fig. 3).

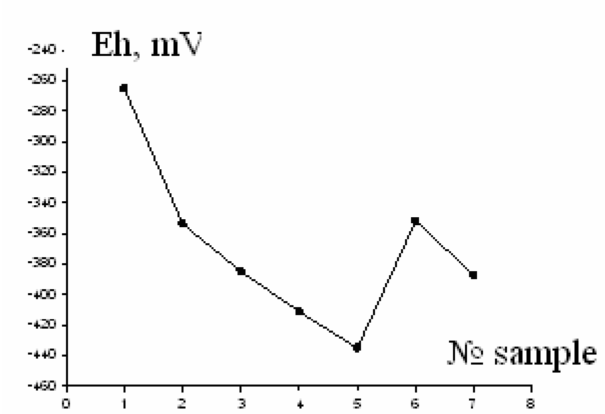

Fig. 3. Change of a redox-potential from the location of sample selection.

It is explained by the fact that samples 1–3 are selected along the stream course with a noticeable current’s speed (38 m/h). And the samples 4 - 7 are actually selected in still water. The waters current increases the concentration of active oxidizers [6]. Therefore redox potential value increases with increasing concentration of natural oxidizers. In these samples COD values is reducing. In still water and at low current speed the quantity of natural oxidizers is insignificant. Therefore high values of COD are observed which is related to high concentration of organic components (the remains of fulvic acids, humic components, etc.) that act as deoxidants. The analyses’ result of sample № 5 (from an underground source) considerably differs from available measurements. COD values, pH (fig. 4) and redox-potential allow to assume existence of technogenic influence on this source (there are fields and gardens with intensive agriculture round a source, the spontaneous dump is situated nearby). Thus, COD values exceed values of maximum permissible concentration more than 10 times. Thus, this spring doesn't function as diluter and doesn't accelerate self-cleaning processes.

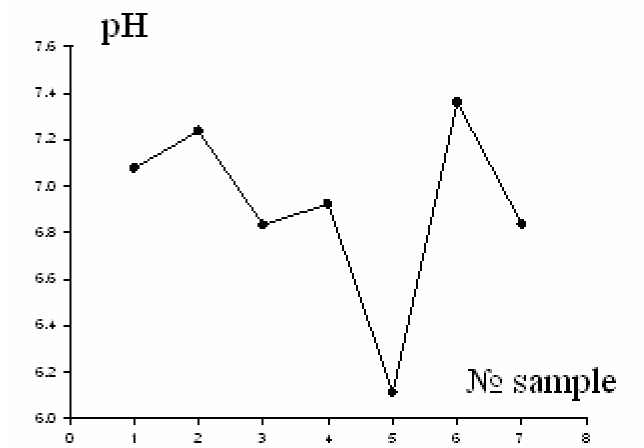

Fig. 4. Change of a pH from the location of sample selection.

Apart from the current's factor, considerable acceleration of oxidizing reactions can be expected at increase of the general mineralization of water that corresponds with increase of ionic force in the solution [7]. The measurements of the general water mineralization (fig. 5) correlate with redox-potential change that confirms the influence of mineral component on oxidizing activity of water.

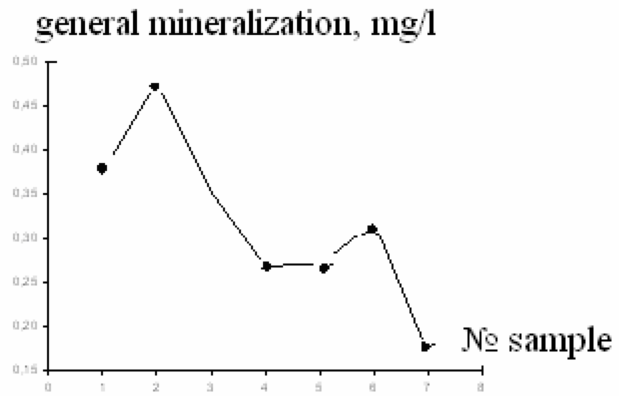

Fig. 5. Correspondence with the general mineralization with the location of sample selection.

The mineralization data analysis showed that the water of river Kurtsi has rather low general mineralization rate (fig. 5) and the EH and pH rates are approaching the standards in the locations № 1 and № 2 water (i.e. in 3 km), and COD data decreased on 40–50 mg-eq./l (practically on 1/3). It testifies the high efficiency of natural processes of self-cleaning in system which consists of some lakes-settlers and a stream with rather high current's speed (38 m/hour). Moreover, there were the clayey and muddy sediments at the bottom of a stream almost everywhere, which took part in the self-cleaning processes [8].

CONCLUSION

1. There was found a correlation of water redox-potential with a current's speed and self-clearing ability of river of Kurtsi.
2. The influence of mineral components on water oxidizing activity is experimentally confirmed.
3. It is determined that self-clearing ability of Kurtsi river is insufficient to oppose.

References

1. Western Lake Erie Basin. Water resources protection plan Ohio, India and Michigan: [electronic resource] // United States Department of Agriculture Natural Resources Conservation Service // – 2005 – P. 24. – access mode page: ftp://ftp-fc.sc.egov.usda.gov/OH/pub/Programs/Lake_Erie/erie_basin_plan.pdf
2. Tchobanoglous G. Wastewater Engineering: (Treatment Disposal Reuse) / G. Tchobanoglous, F.L. Burton, H.D. Stensel; – [4th Edition ed.]. – McGraw-Hill: Metcalf & Eddy, 2003. – 140 p.

3. Measurement of pH, Definition, Standards, and Procedures (IUPAC Recommendation 2002): (Pure Appl. Chem.). / [Chairman R.P. Buck]. –Great Britain International Union of Pure and Applied Chemistry, 2002. –Vol. 74. , № 11 – P. 2169–2200.
4. Garrels R.M. Minerals, Solutions, and Equilibria / R.M. Garrels, C.L. Christ. – London: Jones and Bartlett, 1990. –365 p.
5. Merrill L. Evaluation of Chemical Oxygen Consumed Tests: (Sewage and Industrial Wastes) / L. Riehl. – Water Environment Federation, JSTOR, – 1951. – Vol. 23, No. 11 – P. 1398–1401.
6. Methods for Chemical Analysis of Water and Wastes: (Environmental Monitoring and Support Lab.) / U.S. Environmental Protection Agency – Cincinnati, Ohio: U.S. Environmental Protection Agency, 1979. – 491p. – Publ. 600/4-79-020, rev. Mar. 1983.
7. Kazdobin K.A. Electrochemical Behavior of Diluted Aqueous Electrolytes Contaning Oxygen after Superimposition of Mechanical Effects: J.Water Chem.&Techn / K.A. Kazdobin, E.D. Pershina, E.V. Kokhanenko, and V.Yu. Duma. – Springer., 2009. –Vol. 31, № 3. – P. 177–185.
8. Vilarino T. Effect of Ionic Strength on the Kinetics of the Oxidation of Ascorbic Acid by Hexacyanoferrate(III): Comparison between Specific Interaction Theoriesand the Mean Spherical Approximation.: J. Chem. Research / T. Vilarino, P. Alonso, X.L. Armesto, P. Rodriguez and M.E. Sastre de Vicente. – Science Reviews Ltd., – 1998. – P. 558–559.

Першина Е.Д. Критерии химической оценки водосбалансированных технологий / Е.Д. Першина, Е.М. Филимонова, В.А .Боков, Л.М. Соцкова, Ю.С. Сирошенко, С.Н. Юнусова // Ученые записки Таврического национального университета им. В.И. Вернадского. Серия «Биология, химия». – 2013. – Т. 26 (65), № 1. – С.338-343.
Исследовано влияние антропогенного стресса на физико-химические параметры природной воды. Обнаружена корреляция окислительно-восстановительного потенциала от скорости течения и самовосстанавливающей способности воды. Экспериментально установлено влияние минерализации окислительную активность воды. Обнаружено, что самоочищаюшая способность воды низкая в условиях нарушения водного баланса.
Ключевые слова: редокс активность, окислительная активность, минерализация, антропогенный стресс, биогенные донные отложения, водный баланс.

Першина К.Д. Критерії хімічного оцінювання водозбалансованих технологій / К.Д. Першина, К.М. Филимонова, В.О.Боков, Л.М. Соцкова., Ю.С .Сірошенко, С.Н. Юнусова // Вчені записки Таврійського національного університету ім. В.І. Вернадського. Серія „Біологія, хімія”. – 2013. – Т. 26 (65), № 1. – С. 338-343.
Досліджений вплив антропогенного стресу на физико - хімічні параметри природної води. Виявлена кореляція окислювально-відновного потенціалу від швидкості течії і самовідновлюючої здатності води. Експериментально встановлений вплив мінералізації окислювальну активність води. Виявлено, що самовідновлююча здатність води низька в умовах порушення водного балансу.
Ключові слова: редокс активність, окислювальна активність, мінералізація, антропогенний стрес, біогенні донні відкладення, водний баланс.

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