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CHARACTERISTICS OF HYDRO-ECOLOGICAL SYSTEM OF THE RIVER DNIPRO

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Growth of economic activity greatly contribute into the enhancement of man-made impact on environment; it aggravates existing ecologic problems in the powerful industrial Dnipropetrovsk region and, as a consequence, negatively impacts health and life quality of its inhabitants. In view of this, the aim of our research was to evaluate hydro-ecological state of the river Dnipro near the city of Dniprodzerzhynsk by studying objects and amounts of waste water disposals into the reservoir as well as to assess pollutants content in the river water. The result obtained shown the main sources of the increasing ecological risk in the water area under observation and proven that the water quality of the river Dnipro meets the requirements of the II-III class of quality of surface waters and is characterized by a moderate degree of contamination. The obtained results are the basis for updating set of measures aimed at improvement of ecological state of the water basin in Dnipropetrovsk region.

Key words: water of the river Dnipro, chemical pollutants, hydro-ecological state.

Introduction

Basin of the river Dnipro in Dnipropetrovsk region is related to the unfavourable one as for maintenance and suitability of the qualitative composition of the water [1, 2, 10]. The most challenging state of the water resources is noted in the area of the Lower Dnipro (from Dniprodzerzhynsk to the estuary): here 76% of the water from the total water consumption is used irreversibly and 83% of the polluted water is discharged [8]. The city of Dniprodzerzhynsk of Dnipropetrovsk region is one of the powerful industrial centres in Ukraine, it is infamous as one of the most adverse industrial areas within the territory of 13.26000 ha with the population of more than 280.000 inhabitants [2]. Dniprodzerzhinsk industrial complex numbers about 60 industrial facilities of various branches. A high concentration of enterprises of heavy industry, chemical industry, heat-and-power engineering complexes, containing physically worn out and obsolete workshops, lack of well-functioning water purification equipment, heavy motor load on the environment cause a high degree of degradation of environmental components [9, 10]. The city accumulates millions of tons of industrial wastes, disposed in storages, area landfill, and refuse dumps. An important factor of the existing critical ecological situation within the limits of Dniprodzerzhinsk is residential and industrial waste waters. Surface water discharge and runoff from the city territory are the grave pollutants of the reservoir. The length of the Dnipro along the territory of Dniprodzerzhinsk is about 15 km; most of the waterfront on the right bank is occupied by the industrial zone, a place of untreated industrial sewage discharge [4, 11].

Environmental protection, along with economic integration, is one of the priorities for the European Community. For the period from 2005 to 2016 the EU adopted the Global Water Initiative "Water for life - health, welfare, economic development and security."

Therefore, negative hydro-ecologic and hydro-economic state of the Dnieper basin caused by an intensive anthropogenic pollution of the environment is one of the urgent ecological and hygienic problems nowadays [4, 5, 7]. Thus, the purpose of the work was to evaluate the peculiarities of hydro-ecological system of the river Dnipro.

Materials and methods of research

In the course of the study there were analyzed statistic data of the state recording of the water use - 2TP (water economy) in Dnipropetrovsk region and the city of Dniprodzerzhinsk in particular over 2012. The approved records provides establishing information on water consumers, water quantity and quality, as well as data on the types of water consumption, on the basis of which the distribution of water between objects have been performed and measures for rational water consumption have been developed.

Evaluation of quality of water sources was performed by water sampling taken from the Dnipro, both superficial and deep (total 16 samples). Places of sampling were: settlement Auly, Romankovo, Karnauhivka, and Taromske. Dniprodzerzhynsk Sanitary Station provided support in carrying chemical analysis of the water from the surface water source to identify pH, BOD_5, COD, ammonia nitrogen, nitrites, nitrates, mineral oil, sulphates, chlorides, phenols, solids, and suspended solids. Selection of chemicals and parameters for the research was chosen due to the following factors: 1) they belong to the list of key indicators of water pollution; 2) they are "indicators of influence" of contaminated wastewaters on the state of the reservoir in selected water sampling points, which are located directly at the confluence of the land runoffs. To assess the quality of water photometric, gravimetric and titration methods were used. Hygienic assessment was carried out in accordance with "Sanitary rules and norms of protection of surface waters from pollution" [6].

Results of the research and their discussion

Analysis of the volume of water disposal in the city of Dniprodzerzhynsk testifies that the total amount of wastewaters for 2012 made up over 115 mln m^3/ year, of which about 15% do not pass through the purification. The main pollutants of the Dnipro river is JSC "Dniprovsk Metallurgical Plant",

JSC "Dniprodzerzhinsk HPP", left-bank water and wastewater treatment facilities, Public Utility "City Water Authority", PU "Ekoantylid", JSC "Dniproazot", JSC "Dniprovagonmash", JSC "Bahliykoks", LLC "Dniprodzerzhynsk utility company" (fig. 1). Other companies with a relatively small amount of water consumption or with a high recycling water supply, discharge waters into the city sewerage system and together with household waste water the waters get into city treatment facilities.

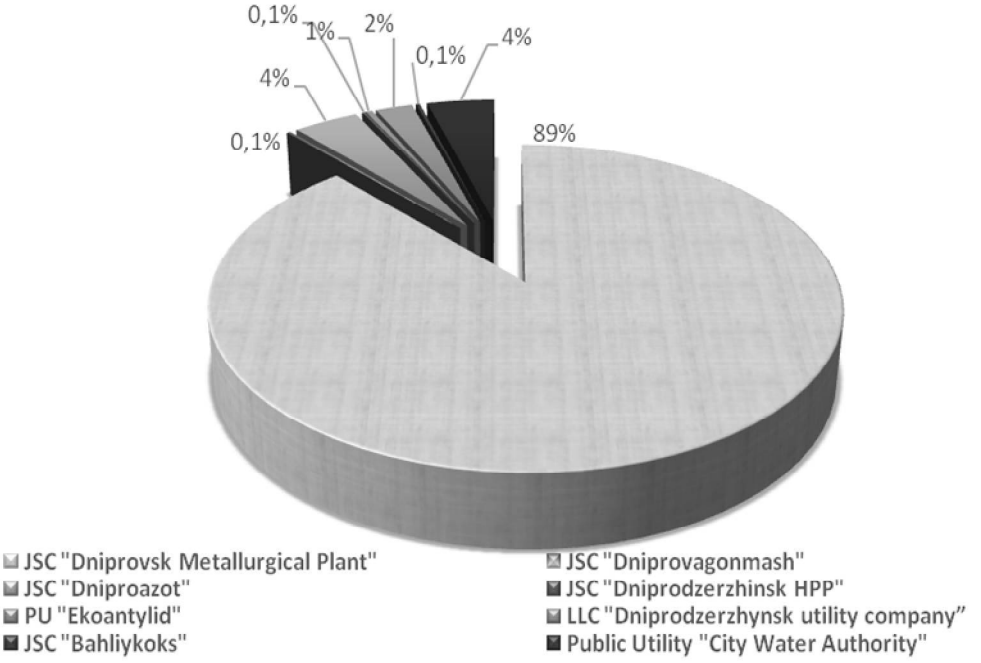

Fig. 1. Proportion of wastewater discharged by enterprises of Dniprodzerzhynsk.

Pollutants under investigation were identified in all water samples, mostly within the established normative values. Hygienic assessment of concentrations of chemical parameters in the water, which was selected near the settlements Auly and Romankove demonstrates a relatively high qualitative composition of the reservoir within the residential zone of the areas under the observation, with substances content corresponding to SanPiN 4630-88. Along with this, in the water of the water source near the village Karnauhivka and village Taromske phosphate concentrations exceeded maximum permissible concentrations (MPC) by 21% (0,17 ± 0,01 mg/dm^3 in MPC - 0.14 mg/dm^3). This fact may testify to pollution with domestic nature predominantly, as these substances are components of household chemicals (detergents, powders etc.) and enter the reservoir on discharge of domestic wastewater.

In the samples taken near the village Karnauhivka, TPH content in the water on average made up - 0.27 mg/dm^3 ± 0,004, which is estimated as excessive compare to the normal (0.23 mg/dm^3). Within the limits of the settlement there was established excess of TPH concentration, the latter being significantly higher in surface samples ($p < 0.05$), this can be due to the oil film on the water surface. Thus, it was assumed, that adverse contamination of the surface layer of the water with oil products is not only of industrial nature, but is caused by a significant amount of these substances in surface runoffs from the adjacent territory, polluted by vehicle emissions.

It should be noted that by almost all the studied parameters in the water samples of the river Dnipro, approaching to the maximum permissible values (80-98% of MPC) is observed, this testifies to a moderate pollution of the reservoir. Presence of significant content of petroleum products and that of iron in the reservoir can be explained by industrial pollution of the river Dnieper. This is indicated by the increase of the iron content within the industrial zone [5] and testifies to the unauthorized discharge of industrial wastewater executed by enterprises and companies.

It is necessary to note that the river Dnipro is the main source of drinking water for the left-bank and right-bank areas of the city Dniprodzerzhynsk. There is no alternative water supply source in the city. Therefore, deterioration of the water basin state poses a problem with natural self-cleaning processes, greatly complicates the process of water treatment at water treatment plants, this in its turn affects the quality of drinking water. Water purification facilities can no longer prevent entry of a significant amount of contaminating inorganic and organic substances into the drinking water and this threatens health of the population [3, 7]. To address the problem of hydro-ecologic instability of technologically contaminated region, it is necessary to update programs on the improvement of the water body [10, 11]. Of course, such projects do exist, however, judging from the current state of the river, one should notice that they are ineffective.

Conclusions and prospects of further researches

Comprehensive analysis of the research results has found that concentration of powerful sources of man-made pollution in the water area of Dniprodzerzhinsk negatively impacts the state of the Dnipro and is characterized by the exceeding of the maximum permissible concentration of petroleum products and that of phosphates. Based on the monitoring data of pollutants, it has been revealed that at the time of observation water quality around the current water source meets the requirements of II-III class of the surface water quality and is characterized as moderately polluted. Accumulation of pollutants leads to deterioration of the water quality by hydro-chemical, hydro-physical and sanitary-hygiene indicators and as a consequence, changes in hydro-biological characteristics, leading to degradation of the Dnipro ecosystem. The ability of the reservoir to self-regulation does not provide disturbed balance, leading to a large-scale river control with destruction of biocommunication [6, 9]. Taking into account that at the expense of the water basin of the river Dnipro over 30 mln. of Ukrainians meet water demands, there is a need in further more detailed ecologic and hygienic scientific research to assess the water quality of water sources, in terms of industrially developed region, this will make it possible to objectively assess the situation and propose a set of measures on improving ecological state of the water basin of Dnipropetrovsk region in order to preserve and restore its natural potential.

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Реферат

ХАРАКТЕРИСТИКА ГІДРОЕКОСИСТЕМИ РІЧКИ ДНІПРО

Головкова Т.А.

Ключові слова: вода р.Дніпро, хімічні забруднювачі, гідроекологічний стан.

Інтенсифікація господарської діяльності, одна із обов'язкових умов подальшого розвитку людського суспільства, супроводжується посиленням антропогенної дії на довкілля, що загострює екологічні проблеми потужного промислового регіону – Дніпропетровської області і негативно впливає на здоров'я та якість життя його мешканців. У зв'язку з цим, нами було поставлено за мету визначити гідроекологічний стан р. Дніпро поблизу міста Дніпродзержинська за допомогою виявлення об'єктів та об'ємів скиду стічних вод у водойму та оцінки вмісту забруднювачів річної води. За результатами досліджень встановлені основні джерела підвищеного екологічного ризику в акваторії спостереження, а також виявлено, що якість води р. Дніпро відповідає вимогам II-III класу якості поверхневих вод і характеризується помірним ступенем забруднення. Отримані результати стали обґрунтуванням для вдосконалення комплексу заходів з покращення екологічного стану водного басейну Дніпропетровського регіону.

Реферат

ХАРАКТЕРИСТИКА ГИДРОЕКОСИСТЕМЫ РЕКИ ДНЕПР

Головкова Т.А.

Ключевые слова: вода р.Днепр, химические загрязнители, гидроэкологическое состояние.

Интенсификация хозяйственной деятельности, одно из обязательных условий развития человеческого общества, сопровождается усилением антропогенного воздействия на объекты окружающей среды, что обостряет экологические проблемы мощного промышленного региона – Днепропетровской области, и как следствие, негативно влияет на здоровье и качество жизни его жителей. В связи с этим, нашей целью стало определение гидроэкологического состояния реки Днепр вблизи города Днепродзержинска с помощью изучения объектов и объёмов сброса сточных вод в водоем и оценки содержания загрязнителей в речной воде. В результате исследований установлены основные источники увеличения экологического риска в акватории наблюдения, а также определено, что качество воды реки Днепр отвечает требованиям II-III класса качества поверхностных вод и характеризуется умеренной степенью загрязнения. Полученные результаты являются обоснованием для совершенствования комплекса мер по улучшению экологического состояния водного бассейна Днепропетровского региона.