ГІГІЄНА

doi: 10.35339/ekm.2019.01.15

UDC 574.5:614.777

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SCIENTIFIC RATIONALE OF MEASURES ON PREVENTION OF POLLUTION OF SURFACE WATER BODIES IN KHARKIV REGION

Today, in Kharkiv region, most of the surface water bodies as a result of man-made and anthropogenic loading have lost their natural purity and the ability to self-purify. One of the features of water resources of the region is that the rivers, which serve as the main sources of water supply, are also used as receivers of treated wastewater. In order to analyze the state of pollution of the aquifer of Kharkiv region during 2007–2016, laboratory studies of water of surface water reservoirs of the 1st and 2nd categories were conducted and summarized. The researchers have found that over the past 10 years the pollution of surface water bodies of the 1st category according to sanitary-chemical indicators is at the level of 4.5%, microbiological indicators – 14%, water pollution of reservoirs of the 2nd category is 20% and 12%, respectively. In order to prevent the occurrence of diseases of different etiology among the population of Kharkiv region, the source of which is the water factor, a set of methodical and practical measures that will contribute to the improvement of the surface water of the region has been developed.

Keywords: *drinking water, laboratory tests, microbiological indicators, sanitary-chemical indicators, preventive measures.*

Introduction

Ukraine's drinking water supply is almost 80% secured from surface sources. The ecological state of surface water bodies and the quality of water in them are the decisive factors of sanitary and epidemic well-being of the population. Potential reserves of surface waters of Ukraine are estimated at about 209.3 km3 per year, of which 25% is formed within the state. At the same time, the majority of river basins according to the hygienic classification of water bodies according to the degree of pollution can be attributed to polluted and very polluted ones [1–3].

Monitoring of water quality in surface water bodies shows that, despite some decline in industrial production in recent years and decrease, in this connection, discharge of waste water from the reservoir, on average, the state tends to deteriorate the ecological state of reservoirs of the 1st class water from which it is used for drinking needs and the 2nd class, which are foreseen for sports, and used as recreation zones for sanitary-chemical and microbiological indicators [4].

Of particular concern is the state of the Dnipro river basin, which provides drinking water to more than 75% of the country's population.

Kharkov region has one of the most developed national economic complexes of Ukraine and borders on industrial regions of Donetsk and Lugansk region, Dnipropetrovsk region and the Russian Federation. The area of the oblast is 31.4 thousand km2. It is located on the watershed of the river basins of Don (the river Siversky Donets) and the Dnieper River. There are 17 administrative districts that belong geographically to the basin of the Seversky Donets River within Kharkiv region, and there are 10 ones that belong to the Dnipro River basin. The region has an extremely low level of water supply – 1.8% of the total resources of Ukraine. Water resources of the region are formed due to atmospheric pre-

cipitation, local runoff, groundwater, as well as due to external influx from adjacent territories (transit water of Russia) [5–6].

At present, in Kharkiv region, a significant part of surface water bodies has lost its natural purity and suitability for self-purification, which indicates a significant man-made and anthropogenic load on the water recreational zones of the region [7–9].

The purpose of the study was to analyze the status of pollution of surface waters of Kharkiv region according to the laboratory research data for the development of scientific and practical and preventive measures aimed at improving the water supply of the population of Kharkiv region.

Materials and methods of research

During 10 years from 2007–2016, laboratory studies of water of surface water reservoirs of the 1st and 2nd category on the basis of institutions and establishments of the State Aviation Service were conducted and the results of existing researches for the specified period were summarized.

The study of the state of pollution of surface water of the reservoirs was evaluated in accordance with the existing normative documents, namely:

– «Sanitary rules and norms of protection of surface water from pollution» (SanPiN 4630-88);

– GOST 17.1.5.02-80 «Protection of nature. Hydrosphere Hygienic requirements for zones of recreation of water objects»;

– State sanitary rules of planning and development of human settlements, approved by the order of the Ministry of Health of Ukraine dated June 19, 1996 №. 173;

– DSTU 4808: 2007 «Sources of centralized drinking water supply. Hygienic and environmental requirements for water quality and selection rules»;

– State sanitary rules of planning and development of human settlements, approved by the order of the Ministry of Health of Ukraine №. 173.

Research results

The surface water resources of Kharkiv region are represented by rivers (867), lakes (583), reservoirs (56), rates (2538) and the Dnipro-Donbas channel [10].

One of the peculiarities of water resources is that the rivers, which serve as the main sources of water supply, are also used as sewage receivers. The problem of pure water remains the number one problem.

Protection of water resources is one of the most complex problems of water management. The surface runoff from the fields carries a large amount of fertilizers and pesticides in the reservoir. The drainage of communal services from settlements is increasing significantly.

Every year the rivers of the region are subject to anthropogenic stress, which leads to a decrease in the ability of water bodies to self-purify and restore water quality.

The main source of pollution of the rivers in the city of Kharkiv is the discharging of untreated storm water, the lack of facilities for the purification of storm sewage in the city.

Improper cleaning of roads, streets, irregular cleaning of drainage wells leads to increased water pollution of rivers of the city. During the flood and the passage of ice, the water quality of the surface water drains considerably. Sediments of rivers are significant sources of secondary intake of microorganisms in water.

Insufficient power and efficiency of existing wastewater treatment facilities leads to a violation of the sanitary-chemical and hydrobiological regimes of rivers, lakes and other surface water bodies.

There are 155 wastewater treatment plants in the region, of which 89 have sewage disposal in open water (including through 78 releases of household sewage and 13 issues of industrial waste water).

Insufficiently purified waste water was discharged through 32 issues (including 29 issues of household and 3 issues of industrial waste water) from the reservoir. Also, up to 1.5 million m^3 of crude surface drainage comes in through the 139 leaflets into the rivers of the region.

One of the reasons for the deterioration of the quality of water of surface water bodies is eutrophication – the increase in the pollution of recreational reservoirs by invasions of alien species, for example, various species of pistachios of the body-shaped (Ristia stratiotes) sections of the river Siversky Donets in Chuhuevsky, Pechenizsky and Zmiyivsky districts of Kharkiv region, and entering the reservoirs with natural drainage contaminated waters from the territory of settlements [10].

Over the past 10 years, according to the analysis of laboratory tests of surface water bodies of the 1st category for sanitary-chemical indicators, the percentage of samples exceeding the maximum permissible concentrations ranges from 1.5% in 2012 to 12.0% in 2010 and averages over 4.5%.

Over the past 10 years, according to the analysis of laboratory studies of surface water reservoirs of category I microbiological indicators, the

percentage of samples exceeding the maximum permissible concentrations ranges from 4.3% in 2016 to 27.4% in 2007 and averages over 14% (*tab. 1*).

In some years, significant deterioration of water quality according to sanitary-chemical and especially microbiological indicators was due to accidents at the sewage treatment facilities of the districts of the region, which is confirmed by the analysis of official reports of the relevant structures (*fig. 1*).

Much worse quality of water is selected from surface waters of the 2nd category.

Over the past 10 years, according to the analysis of laboratory tests of surface water bodies of the 2nd category, according to sanitary-chemical indicators, the percentage of samples exceeding the maximum permissible concentrations ranges from 14.5% in 2013 to 25.0% in 2009 and averages over 20.0%.

Over the past 10 years, according to the analysis of laboratory studies of surface waters of the 2nd category, according to microbiological indicators, the percentage of samples exceeding the maximum permissible concentrations ranges from 6.0% in 2009 to 25.5% in 2005 and averages over 12% (*tab. 2*).

However, as shown by the results of the research, the indicators of water pollution of the reservoirs of the 2nd category have no sharp changes, as it is established in the reservoirs of the 1st category. This is due to the fact that the main wastewater treatment facilities are the Siversky Donets River, which is a source of drinking water supply in Kharkiv region (*fig. 2*).

Table 1. The generalized data of research on the quality of water of surface water reservoirs of the 1st category of Kharkiv region in the period of 2007–2016 (percentage of samples with excess MAC)

Selection Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
The reservoirs of the 1st category of Kharkiv region (the Seversky Donets river basin)										
Sanitary-chemical indexes	6,8%	4,0%	1,6%	12,0%	3,6%	1,5%	3,5%	6,9%	2,9%	2,4%
Microbiologic Indexes	27,4%	25,5%	12,0%	19,2%	18,2%	10,8%	11,2%	5,9%	4,6%	4,3%

Discussion

By the scientists of Kharkiv National Medical University in order to prevent the contamination of surface water reservoirs of the 1st and 2nd categories as well as for the prevention of the morbidity of the population and improvement of the rest in the reservoirs which serve as areas of recreation:

– an ecological and hygienic component to the general scheme of use of water objects of the basin of the river Siversky Donets has been drawn up;

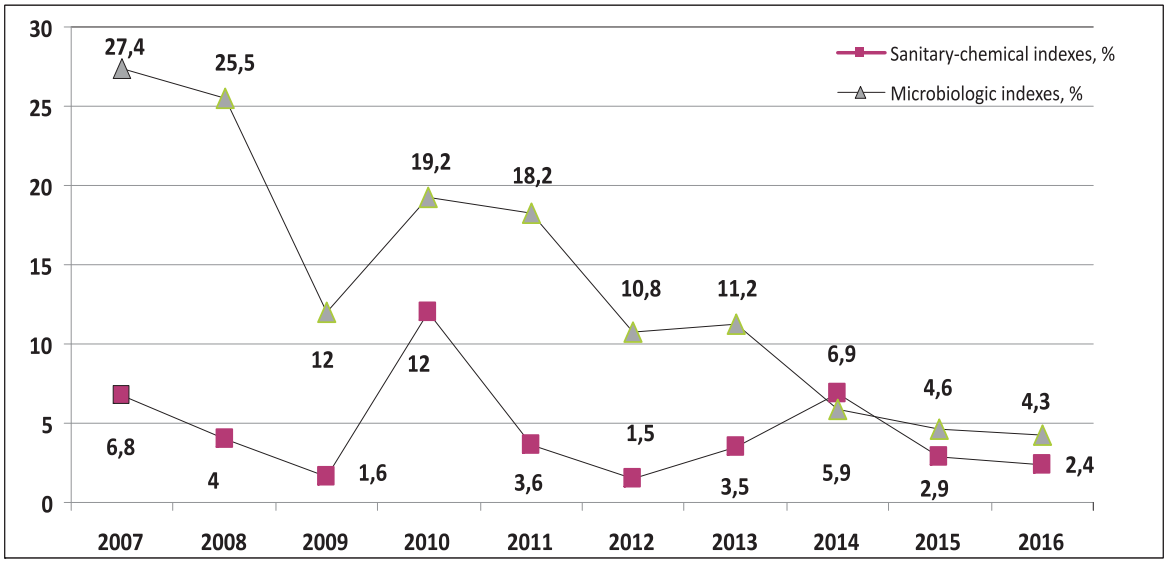

Fig. 1. Dynamics of changes in water quality indicators for surface water reservoirs of the 1st category in the period 2007–2016

Table 2. The generalized data of water quality studies of surface water reservoirs of the 2nd category of Kharkiv region in the period of 2007–2016 (percentage of samples with excess MAC)

Selection year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
The reservoirs of the 1st category of Kharkiv region (the Seversky Donets river basin)										
Sanitary-hemical indexes	19,9%	19,1%	25,0%	20,3%	23,5%	22,0%	14,5%	19,2%	18,6%	19,4%
Microbiologic Indexes	17,3%	13,3%	11,7%	12,9%	10,6%	11,3%	25,8%	12,4%	11,6%	12,5%

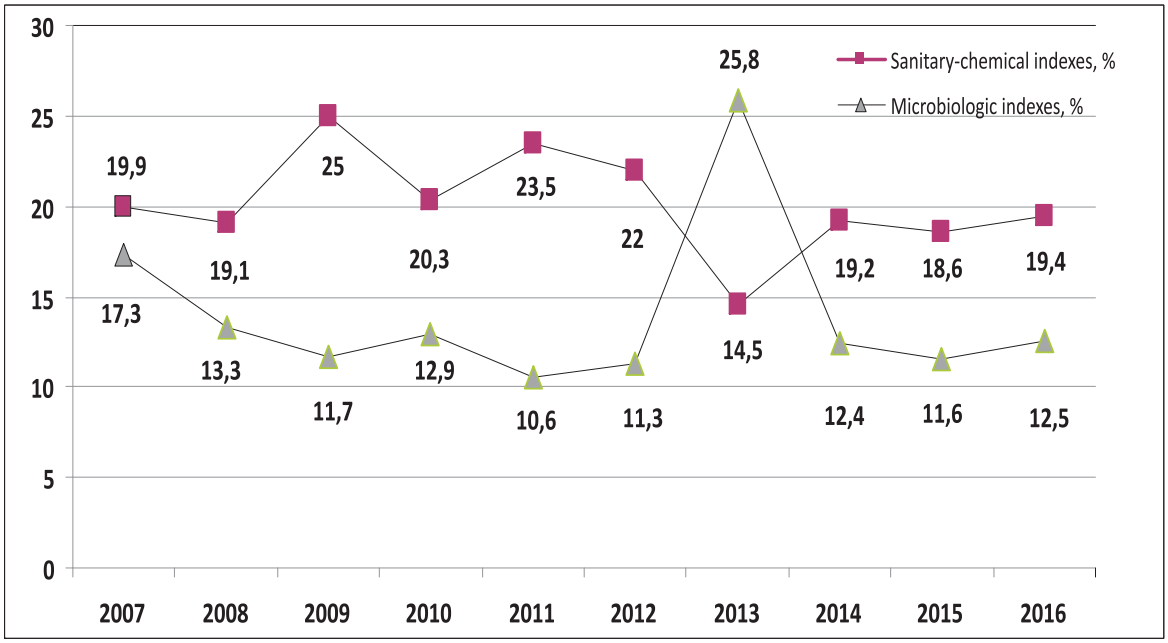

Fig. 2. Dynamics of changes in water quality indicators for surface water reservoirs of the 2nd category in the period 2007–2016

– an information sheet on scientific (scientific and technical) products intended for practical application in the field of healthcare «Method of assessment of the degree of medical and ecological stress in the area of the location of the water recreational zone» №. 76 – 2016 has been prepared;

– ecological-hygienic concept on public health protection in water recreation zones has been developed.

Today, the research materials have been submitted to obtain the Patent of Ukraine for the invention on how to determine the assessment of existing risk for both reservoirs and for public health.

In order to improve the sanitary and ecological state of surface reservoirs, the scientists of Kharkiv National Medical University have developed and implemented a set of preventive measures, the main of which are:

– conducting a thorough analysis of the causes of deterioration or improvement of the quality of water of open water bodies by the scientists;

– scientific substantiation of proposals for the implementation of measures to stop discharges of insufficiently cleaned and untreated sewage into the reservoir, disinfection of waste water (special attention is paid to the treatment facilities located in rural settlements);

– continuous monitoring of pollution levels of surface water bodies by organoleptic, physic-chemical, microbiological indicators, as well as on salts of heavy metals, pesticides, strontium and cesium;

– to ensure work with the media on informing the state of surface water and drinking water.

The aforementioned measures can be used for implementation in other regions of Ukraine, subject to the consideration of the specifics and features of the use of surface water bodies.

Conclusions

The researches have determined that for the last 10 years the pollution of surface water bodies of the 1st category in terms of sanitary-chemical indicators is at the level of 4.5%, microbiological indicators of 14%, water pollution of reservoirs of the 2nd category of 20% and 12% respectively.

It has been established that the main causes of pollution of surface water bodies are untreated wastewater and a significant anthropogenic load on the surface reservoirs.

The scientists of Kharkiv National Medical University have developed a set of methodological and practical measures to prevent the emergence of diseases of different etiology, the source of which are water factors, introduced in the activities of scientific institutions and utilities in Kharkiv region, as well as in the educational process of higher educational institutions in Ukraine.

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НАУКОВЕ ОБҐРУНТУВАННЯ ЗАХОДІВ З ПОПЕРЕДЖЕННЯ ЗАБРУДНЕННЯ ПОВЕРХНЕВИХ ВОДОЙМ ХАРКІВСЬКОЇ ОБЛАСТІ

На сьогодні у Харківській області більша частина поверхневих водоймищ внаслідок техногенного та антропогенного навантаження втратила природну чистоту та можливість до самоочищення. Однією із особливостей водних ресурсів регіону є те, що річки, які служать основними джерелами водопостачання, використовуються також у якості прийомників очищених стічних вод. З метою аналізу стану забруднення водоносного горизонту Харківської області протягом 2007–2016 років проведені та узагальнені лабораторні дослідження води поверхневих водойм I та II категорії.

Дослідженнями встановлено, що за останні 10 років забруднення поверхневих водойм I категорії за санітарно-хімічними показниками знаходиться на рівні 4,5 %, мікробіологічними показниками – 14 %, забруднення води водойм II категорії складає 20 та 12 % відповідно.

З метою профілактики серед населення Харківської області виникнення захворювань різної етіології, джерелом яких є водний фактор, розроблено комплекс методично-практичних заходів, які сприятимуть оздоровленню поверхневих водойм регіону.

Ключові слова: *питна вода, лабораторні дослідження, мікробіологічні показники, санітарно-хімічні показники, заходи профілактики.*

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НАУЧНОЕ ОБОСНОВАНИЕ МЕРОПРИЯТИЙ ПО ПРЕДУПРЕЖДЕНИЮ ЗАГРЯЗНЕНИЯ ПОВЕРХНОСТНЫХ ВОДОЕМОВ ХАРЬКОВСКОЙ ОБЛАСТИ

На сегодня в Харьковской области большая часть поверхностных водоемов в результате техногенной и антропогенной нагрузки потеряла естественную чистоту и возможность к самоочищению. Одной из особенностей водных ресурсов региона является то, что реки, которые служат основными источниками водоснабжения, используются и в качестве приемников очищенных сточных вод. С целью анализа состояния загрязнения водоносного горизонта Харьковской области в течение 2007–2016 годов проведены и обобщены лабораторные исследования воды поверхностных водоемов I и II категории.

Исследованиями установлено, что за последние 10 лет загрязнение поверхностных водоемов I категории по санитарно-химическим показателям находится на уровне 4,5 %, микробиологическим показателям – 14%, загрязнение воды водоемов II категории составляет 20 и 12 % соответственно.

С целью профилактики среди населения Харьковской области возникновения заболеваний различной этиологии, источником которых является водный фактор, разработан комплекс методически-практических мероприятий, которые будут способствовать оздоровлению поверхностных водоемов региона.

Ключевые слова: *питьевая вода, лабораторные исследования, микробиологические показатели, санитарно-химические показатели, меры профилактики*.

Надійшла до редакції 04.02.2019

Контактна інформація

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