ЕПІДЕМІОЛОГІЧНІ АСПЕКТИ

UDC 613.3(477.53)

DOI https://doi.org/10.31718/mep.2020.24.1-2.03

HYDRO-HYGIENIC ASSESSMENT OF FRESH WATER IN POLTAVA REGION FOR DRINKING AND RECREATIONAL USE

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Проблема забезпечення потреб населення України якісною питною водою в XXI столітті з актуальної перетворюється в гостру. Питання не тільки в зниженні кількісних об'ємів прісної води, що загрожує кризою питного водопостачання окремим регіонам країни, а також в тому, що на перше місце виступає якість природних вод, що не задовольняє сучасні гігієнічні вимоги. Це пов'язано з ростом забрудненості природних водних басейнів відходами промисловості, сільськогосподарського виробництва та комунального водокористування. В медичному та еколого-гігієнічному аспекті на перший план виступають питання облігатної контамінації вододжерел глобальними токсикантами органічної та неорганічної природи, знезараження питних та господарських вод, очистки стоків, водо підготовки та ін. В роботі були використані дані Державного управління охорони навколишнього природного середовища в Полтавській області (2010 – 2017 рр.), статистичні матеріали санітарно-епідеміологічної ситуації у водопостачанні області. За даними Полтавського обласного управління водних ресурсів річкова мережа Полтавської області включає: одну велику річку – Дніпро, яка протікає в межах області на ділянці довжиною 145 км, 8 середніх річок загальною протяжністю 1360 км (Псел, Хорол, Ворскла, Сула, Удай, Оржиця, Оріль, Мерла) та 1771 малих річок, водотоків і струмків загальною протяжністю 11501 км. Основними водоносними горизонтами, придатними до питного використання, на території області є: четвертинний (алювіальний) Полтавський, Харківський, Бучакський, Сінеман-нижньокрейдовий і Юрський. Усього в Полтавській області налічується понад 200 тисяч шахтних колодязів, якими користуються близько 605 тисяч людей (36% населення). У 56% колодязів виявлено значне перевищення вмісту нітратів. Нітрати потрапляють у горизонти підземних вод з відходами життєдіяльності людини і тварин (із не забетонованих вигрібних ям), та надмірного внесення азотних добрив. Загалом забезпеченість Полтавської області прісною водою питного та рекреаційного призначення можна вважати достатньою. Але у відношенні якісних показників існують проблемні періоди – жаркий період року є несприятливим для водопостачання населених пунктів з водозабору з басейну Дніпродзержинського водосховища. Для населення, що використовує підземні водні горизонти (верховодку, Полтавський та частково Харківський) такими проблемними періодами є весна та осінь, коли спостерігається більш інтенсивне забруднення цих горизонтів надходженням талих та дощових вод.

Ключові слова: водні ресурси Полтавської області, питне водопостачання, рекреаційне водокористування.

The problem of providing the needs of the population of Ukraine with quality drinking water in the XXI century from the actual becomes a sharp one. The question is not only the reduction of quantitative volumes unleavened water, which is threatened by a crisis of drinking water supply to certain regions of the country, and also that it is the first place to act quality of natural waters, which does not satisfy modern hygienic requirements. This is due to the increased pollution of natural water basins by industrial waste, agricultural production and municipal water consumption. In the medical and ecological-hygienic aspect, the issues of obligate contamination of water sources with global toxicants of organic and inorganic nature, disinfection of drinking and economic waters, sewage treatment, water preparation, etc. are the foremost issues. In this work, data from the State Environmental Protection Department in the Poltava region (2010 - 2017), Statistical materials of the sanitary-epidemiological situation in the water supply of the region were used. According to the Poltava regional water resources department, the river network of the Poltava region includes: one large river - the Dnieper, which flows within the region on a 145 km long section, 8 medium rivers with a total length of 1360 km (Psel, Khorol, Vorskla, Sula, Uday, Orzhitsa, Oril, Merla) and 1771 small rivers, watercourses and streams with a total length of 11501 km. The main aquifer horizons suitable for drinking use in the region are: Quaternary (alluvial) Poltava, Kharkiv, Buchak, Sineman-Lower Cretaceous and Jurassic. In total in the Poltava region there are more than 200 thousand shaft wells, which are used by about 605 thousand people (36% of the population). In 56% of wells, a significant excess of nitrate content was detected. Nitrates fall into the horizons of groundwater with human and animal

To cite this English version: Komyshan I.V., Sarhosh O.D., Aleksejeva A.V., Katrushov O.V.Hydro-hygienic assessment of fresh water in poltava region for drinking and recreational use // The Medical and ecological problems. – 2020. - Vol 24, № 1-2. - P. 12-15.

waste (from non-concreted cesspools), and excessive nitrogen fertilization. In general, provision of the Poltava region with unleavened water for drinking and recreational purposes can be considered sufficient. But in relation to qualitative indicators there are problematic periods - the hot season is unfavorable for water supply of settlements on the water intake from the Dniprodzerzhynsk reservoir basin. For the population using the underground water-mountain umbrellas (upper water, Poltava and partially Kharkiv), these problem periods are spring and autumn, when there is more intense pollution of these horizons by the flow of meltwater and rainwater.

Keywords: water resources of the Poltava region, drinking water supply, recreational water use.

This article is a part of research project of Ukrainian Medical Stomatological Academy "Ecological-hygienic assessment of monitoring data on surface water pollution in the Dnipro basin in the middle current with the use of zooplankton aquatic organisms as biological indicators" (State registration № 0106U001646).

The problem of providing the needs of the population of Ukraine with qualitative drinking water in the XXI century from the actual becomes a sharp one. The question is not only in reducing the quantitative volumes of unleavened water, which is threatening the crisis of drinking water supply to certain regions of the country, as well as the fact that the first place is the quality of natural waters, which does not meet modern requirements. This is due to the increased pollution of natural water basins by industrial waste, agricultural production and communal water use [2, 3, 4, 5, 9]. Outdated equipment and imperfect technologies of physico-chemical and biological purification of utilized municipal water supply utilities also make a significant contribution to the deterioration of natural water quality indicators. This is especially true of surface natural water basins, where there are discharges and drains of used water volumes [1, 6, 8]. And if one takes into consideration the fact that about 39 million Ukrainians receive drinking water supply from the sources of the Dnipro water basin (mostly superficial), then the problem of providing people with quality drinking water is very acute [4, 7, 10].

Thanks to the fundamental and comprehensive value of water for human life (water is the second most important, after air, life support factor) the problem becomes complex and multifactorial. In the medical and ecological-hygienic aspect at the forefront are issues of obligate contamination of water sources by global toxicants of organic and inorganic nature, disinfection of drinking water and economic waters, sewage purification, water preparation and other problems of modern water use.

The above problems of water supply to the population are equally applicable to the Poltava region. However, there are some peculiarities, which are related to the geological and geographical location, the availability and the possibility of using surface and underground natural basins for drinking water supply and recreation, economic development of industry, agricultural policy, etc.

Materials and methods

In this work, data from the State Department of Environmental Protection in the Poltava region (2010-2017), statistical materials of the sanitary and epidemiological situation in the water supply of the region, normative provisions of the Laws of Ukraine were used:

- «Pro zabezpechennya sanitarnogo ta epidemiologichnogo blagopoluchchya naselennya» as of 24.02.1994 № 4004-XII;
- «Pro pitnu vodu ta pitne vodopostachannya» № 2918 – III as of 10.01.2002;
- "Pro zatverdzhennya zagal'noderzhavnoi programi «Pitna voda Ukraini» na 2006-2020 rr.» as of 3 March 2005 №2455-IV.

Results and discussions

Poltava Region belongs to the central part of the Left Bank of Ukraine. Center and north are within the limits of the Dnieper-Donetsk hollow, and the southern part - within the Eastern European plain. The relief of the region is mostly flat with insignificant absolute marks (50-150 meters above sea level). The Poltava region is located in the drainage basin of the Dnipro River in the middle reaches. The slope of the surface of the area determines the prevailing the direction of the river network: almost all the rivers flow from north to south or from north-east to southwest and are the left tributaries of the Dnieper.

The area occupied by water objects is 148,431 thousand hectares, or 5.2% of the region. The territory of the region is covered by a dense network of rivers (about 1780 rivers), with a total length of 13006 kilometers.

According to the Poltava regional water resources department, the river network of the Poltava region includes: one large river - the Dnieper, which flows within the region on a 145 km long section, 8 medium rivers with a total length of 1360 km (Psel – 350 km, Khorol – 241 km, Vorskla – 226 km, Sula – 213 km, Uday – 129 km, Orzhitsa – 89 km, Oril – 80 km, Merla – 28 km) and 1771 small rivers, watercourses and streams with a total length of 11501 km, including small rivers with a length of more than 10 km in the region, there are 137, their total length is 3596 kilometers. The main sources of water resources of the region are the Sula, Psel, Vorskla, Orel and their tributaries, as well as the Kremenchug and Dneprodzerzhinsk reservoirs on the Dnipro river.

The hydrographic network of rivers is moderately developed, its average density, without taking into account small rivers, watercourses and streams of less than 10 km, is 0,17 km per 1 km^2, and with their account - 0,45 km per 1 km^2, which is almost the same as the average density of the river network in Ukraine. There are 69 small reservoirs in the region with a total area of water mirror 6469,5 ha and a total volume of 149,87 mn.m^3; 2688 ponds with a total area of a water mirror of 19969 hectares and a total volume of 278,072 million m^3; 583 lakes, the total area of the water mirror of 4534 hectares and a total volume of 7.85 million square meters of water.

In the south and southwest the oblast is adjacent to two large reservoirs - Kremenchuk and Dneprodzerzhinsk, the total volume of which is 13520 and 2450.94 million m^3 of water regulated there.

Natural resources of groundwater is one of the main sources of economic- drinking water supply to the settlements of Poltava region. Underground waters lie in the form of several aquifers, which differ in their reserves and chemical indices.

The main aquifers, suitable for use, in the territory of the region are: Quaternary (alluvial) Poltava, Kharkiv, Buchak, Sineman-Lower Cretaceous and Jurassic. The most abundant Buchak aquifer, which lies at relatively shallow depths and throughout the region.

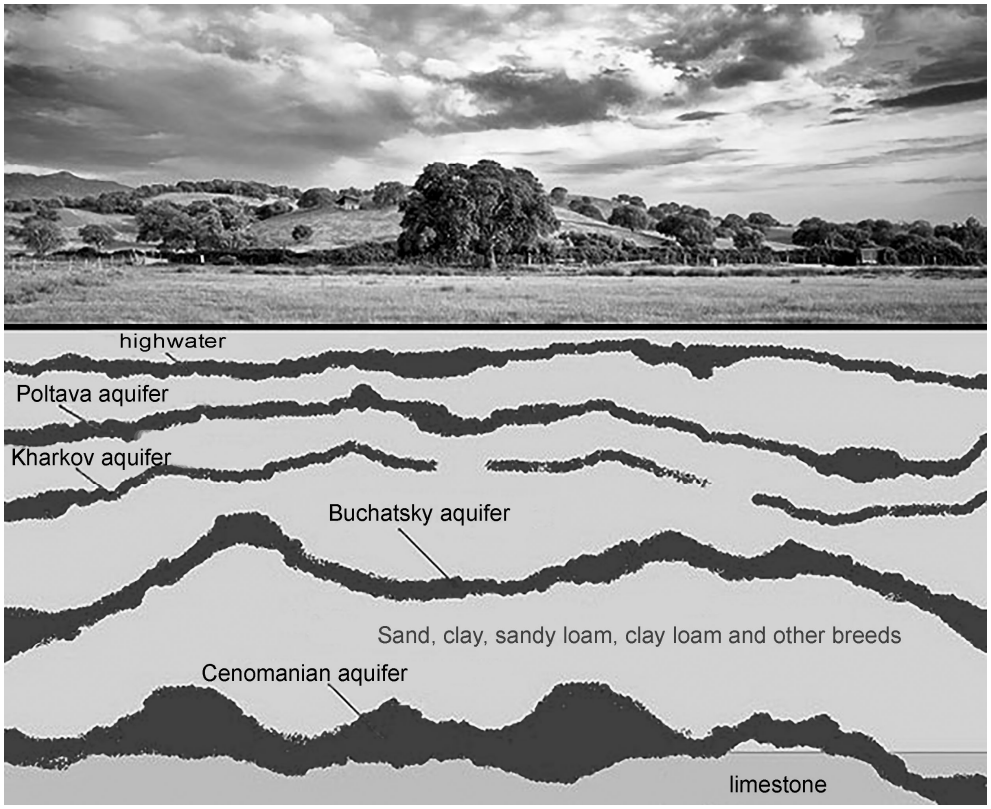

Figure 1. The main aquifers of the Poltava region.

On the greater part of the Poltava Plain the first groundwater horizon from the surface on the watersheds (in quaternary loess rocks, moraine loams, etc.) is located at depths from 2 to 18 m.

Waters are weakly mineralized (up to 1 g/l), have a high rigidity (24-35 mg-ekv/l), predominantly calcium-magnesium bicarbonate, which are used with shaft wells in the countryside. In the south of the region, within the limits of the properland of the Dnieper Lowlands, the aquifers in the anthropogenic deposits of the floodplain terraces of the Dnieper have a greater mineralization, but less rigidity, hydrocarbon-sulfate-magnesium-calcium or hydrocarbon-calcium-sodium composition. They lie closer to the surface, but they are also used by shaft wells.

The largest consumers of water were the housing and dairy sector (51.5%) and industry (35.5%). High rates of water consumption from ferrous metallurgy enterprises (50.4% of consumer prices), food industry (26.4%) and energy (12.3%).

In rural areas, the water supply problem of the population has been aggravated due to chemical and bacterial contamination of water sources. Rural population of Ukraine mainly consume water from wells and individual boreholes, which (in the vast majority) are in unsatisfactory technical and sanitary conditions.

In total in the Poltava region there are more than 200 thousand shaft wells, which are used by about 605 thousand people (36% of the population). In 56% of the wells, a significant excess of nitrate content was detected (in some Semenivsky district samples - up to 50 times!). Nitrates fall into the horizons of groundwater with the waste of human and animal life (from non-concreted cesspits) and excessive application of nitrogen fertilizer.

For centralized water supply for most towns and villages and some small villages use an aquifer complex in the deposits of the Kaniv and Buchak slabs of the Paleogene, mostly from a depth of 60-75 m, is rarely deeper. The water of these horizons is unleavened, soft, mainly hydrocarbon-sodium, among the trace elements contains fluoride ions.

For centralized water supply in Poltava, an aquifer system is used in Cretaceous deposits, from a depth of 400-1000m (unleavened and slightly mineralized water, predominantly chloride-hydrocarbonate-sodium).

The total forecast resources of groundwater in the Poltava region are 4060.5 million cubic meters per year, and their explored and approved operational resources are 807 million cubic meters per year.

The centralized water supply of the communal services of the cities of Kremenchug and Horishni Plavni is carried out mainly as a result of the collection of water from the Dnieper.

Water preparation is carried out at the Kremenchug purification facilities drinking water supply followed by disinfection with gaseous chlorine.

Due to outdated equipment and water preparation technology every year in the hot period of the year, the quality of drinking water supplied to the population of the specified settlements is sharply decreased. This is due to the intensive reproduction of blue-green algae in the Dniprodzerzhynsk reservoir basin.

On average 3-4% of samples in the sources of centralized water supply in the region do not meet the standard for bacteriological and 7-10% - for chemical indicators. The worst water quality in water supply networks in both groups of indicators is observed in Kremenchug, Kozelshchinsky, and Globynsky districts.

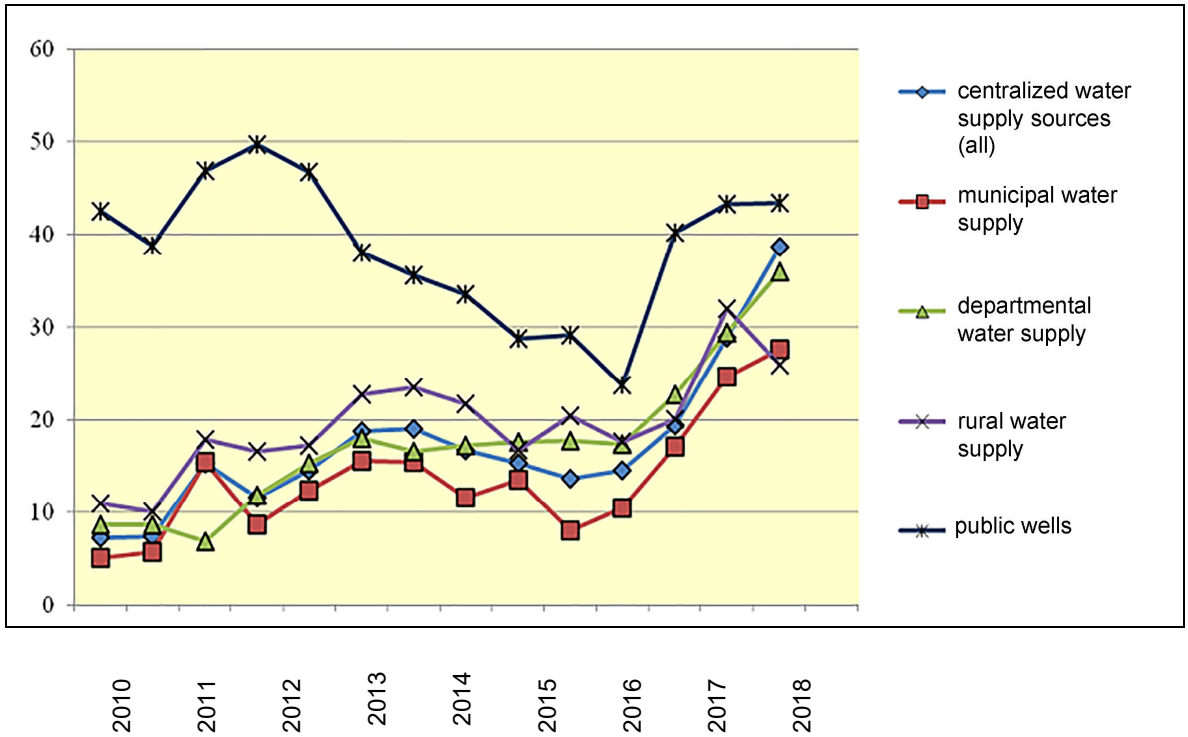

Figure 2. Specific gravity of samples of drinking water from sources of water supply, which did not meet the standards for chemical indicators,%.

Conclusions

In general, provision of the Poltava region with unleavened water for drinking and recreational purposes can be considered sufficient. But in terms of qualitative indicators there are problematic periods - the hot period of the year is unfavorable for the water supply of settlements on the water intake from the Dniprodzerzhynsk reservoir basin. For the population using the groundwater horizons (highwater, Poltava and partially Kharkiv), these problem periods are spring and autumn, when there is more intense pollution of these horizons by the flow of ice water and rainwater.

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Матеріал надійшов до редакції 24.12.2019.