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ЕКОЛОГІЯ НА ТРАНСПОРТІ

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WATER REALITY IN UKRAINE AND WORLDWIDE

Purpose. The paper analyzes the state of water management in Ukraine and worldwide, as well as the best practices in this area. **Methodology.** The study was carried out based on the analysis of literature sources and reporting data on the state of water management in Ukraine, European countries, the USA (2010-2016). **Findings.** The water state analysis in the regions of Ukraine showed that the quality in most cases is close to or meets the requirements for drinking water. Drinking tap water requires post-treatment in all regions of the country. The main issue for today is the production of the necessary equipment for treatment plants. Unfortunately, not all equipment is produced in Ukraine. The condition of rural water pipelines is of particular concern. Among the tested pipelines 7.3% do not comply with the rules and regulations. At the same time, only 25% of villages in Ukraine are provided with centralized water supply. **Originality.** The authors presented the results of a comprehensive review of the world's issues on disinfection of drinking and waste water, where various methods are used, partly in combination with each other in Ukraine and the worldwide. The main unresolved issue today is the issue of the residual quantity of drugs in the drinking water. The main environmental threat of the world scale is the presence of medicines in drinking water. The treatment facilities are not suitable for the decomposition or trapping of medicinal products. Nowhere in the world there is protection from these substances. One of the key issues in the solution of drinking water production is seawater desalination. To reduce the cost of desalination of sea water the SWRO-membrane technology is used. **Practical value.** Water problems are number one problems all over the world and in Ukraine as well. It is necessary to provide for additional financing to solve problems in the preparation and purification of waters, not with whatever funds remain, taking into account the fact that water is the basis of life on earth as a whole, the health and life of the nation depends on the quality of the water supply source.

Key words: waste and drinking water treatment; medicines in wastewater; new sources of drinking water; disinfection of waste and drinking water; desalination plants; fresh water production from seas

Introduction

Let's try to look into the future and believe in the reality created on the screen. The films of 2008 «James Bond. Agent 007: Quantum of Solace» and 2015 «Mad Max: Fury Road» have one common global storyline, where the main roles are played by water resources [1]. They do not just convince us of this, but rather state that water is becoming a means by which the world's main problems can be solved in aggregate: food, energy, economic, health and climate change.

According to UNESCO's predictions, in 2020, lack of water will be one of the main world prob-

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lems and possibly cause of wars in the region of China, India, Pakistan, where the largest number of people live and there is a great lack of water. This is predicted by the Norwegian scientist Terje Tvedt in his book «A Journey in the Future of Water» [12]. The author warns us that the most terrible wars of humanity are yet to come, and these will be wars for the right to have water. Today all over the world the agenda has the questions of the future existence of mankind, which, not for the first time in history, is directly associated with water resources and our capabilities to manage them.

Another environmental specialist L. Ron Hubbard said: «Humanity has reached such a level of development that it can destroy the planet. Now we need to raise it to a level where it would be able to save it and begin to act in this direction». [14].

Top 5 global risks for the next 10 years (≈ 2026): 39.8% – water crisis; 36.7% – insufficient measures to mitigate the climate change effects and adapt to them; 26.5% – extreme weather events; 25.2% – food crisis; 23.3% – deep social instability [1–20].

Purpose

Problems related to the quality of drinking water are of concern to millions of people in Ukraine, regardless of the regions in which they live. Most of the country's population uses tap water in everyday life. In this regard, from year to year for any resident there is a relevant question: is this water suitable for drinking? Do we need to clean it up with filters? Is it possible to get high quality water in the given conditions from tap water, the quality and taste of which often leaves much to be desired?

Methodology

The information search conducted by us showed that most often the water service company is one of the oldest municipal buildings in the city, which is not surprising, since the centralized water supply system began to be laid in the late XIX – early XX centuries (Table 1) [7]. The length of the water supply network is both an advantage and a disadvantage.

The advantage is: the longer the water supply network, the more houses and enterprises can receive purified water; the disadvantage is that it is more difficult to ensure water bacteriological safety.

Table 1

General information about water service companies of Ukraine (according to the official websites of water service companies)

Public utility company	Established, year	Length of water supply network, km
PJSC AK Kievvodokanal	1874	4000
KP Donetskgorkvodokanal	1932	3500
KP Dniprovodokanal	1869	2002
KP Kharkivvodokanal	1881	2570
Infosvodokanal (Odessa)	1873	1400
KP Mykolaivvodokanal	1906	1200
KP Lvivvodokanal	1901	1100
KP PRC Poltavavodokanal	1900	817
KP Cherkasyvodokanal	1914	460

The scheme of water treatment used in Ukrainian utility companies is traditional and consists of the following stages: dosing of reagents (coagulant, flocculant, oxidizer), mixing and settling, filtering, decontamination, supply to the consumer. All enterprises for water disinfection use chlorination, the exception is the Dnipro station where ozonization is used (Kiev). It should be noted that the equipment used for water disinfection in most cases is extremely deteriorated and requires immediate reconstruction.

Requirements to water quality according to the main indicators by DerzhSanPin 2.2.4.–171–10 «Hygienic requirements for drinking water, intended for human consumption»:
Dry residue, mg/l ≤ 1000
Permanganate oxidability, mgO2/l ≤ 5
Color, degrees ≤ 20
Hardness, mg-eq/l ≤ 7
Aluminum, mg/l ≤ 0.2
Manganese, mg/l ≤ 0.05

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Sulphates, mg/l ≤ 250
Chlorides, mg/l ≤ 250
Nitrates, mg/l ≤ 50
Fluorides, mg/l ≤ 1.5

As shown by the research data, the following above-limit values were noted according to the requirements of DerzhanSanPin 2.2.4.-171-10 [5]:

– oxidation (from 4.4 to 8.8 mgO2/l) and colour (from 21 to 38 degrees) – in samples of tap water in the cities of Dnipro, Kiev, Cherkassy, Donetsk, Nikolaev, this is due to a significant content of natural organic (humic) compounds in surface water – sources of water supply;

– hardness (from 7 to 8.5 mg-eq/l) – in the samples of the cities of Donetsk, Kharkiv, Lviv, which is conditioned by groundwater (or make up of groundwater) in water supply sources;

– iron – in water samples of the city of Lviv (0.38 mg/l);

– aluminum – in the water of Donetsk and Kiev, which is associated with the use of the corresponding coagulants in the cleaning technology.

Findings

The obtained water quality monitoring data in the regions of Ukraine during the flood period showed that not everything is as bad as one could imagine, and despite the scandalous Internet messaging, the quality of tap water in various cities of Ukraine is in most cases close or meets the requirements for drinking water. However, it is also obvious that tap water in all regions should be additionally purified.

Provision of Ukraine with water resources, despite the abundance of various small and large reservoirs. Ukraine is one of the least well-water-resourced countries in Europe [10].

Provision of European countries with water resources (thousand m^3 per year per inhabitant): Ukraine – 1.2; Sweden – 24.0; Europe – 8.6; Austria – 7.7; Switzerland – 7.3; France – 4.6.

Regions of the country are provided with water in different ways. So, in Uzhhorod we reach the level of 6.27 ths. m^3 per year per inhabitant of the prosperous Switzerland, and in the Odessa region (0.14 ths. m^3 per year per inhabitant) we go down to the level of arid Algeria.

In general, for more than half of the country's territory, the level of water supply corresponds to the gradation «catastrophically low».

Imbalance, the difference between the required amount of water and available, exceeds the value of 10 ths. m^3 per year per person («catastrophic») and is observed in 5 southeastern regions of Ukraine. Also five regions can be considered the «balanced» (less than 1 ths. m^3 per year per person) – four western and one northern region. On the average, Ukraine is in the zone between «permissible» (from 0.1 to 0.3) and «extraordinary» (1.0 to 2.0) unbalance. In this case, it is necessary to think about alternative sources of water supply (for example, reuse of wastewater, seawater desalination, etc.)

Ukraine consumes 15 km^3 of water a year. Basically, water comes from surface freshwater sources of 12.15 km^3 per year or 81%, mainly from the Dnieper River – 9.3 km^3 of water per year or 77%. This amounts to approximately 26% of the total water in the Dnieper. Underground water makes up 13%, and seawater – 6%.

Water, taken from underground sources, does not reach the consumer due to the high content of salts and the profitability of its preparation. This applies to mine waters, the content of which in the total volume of groundwater withdrawn is 60 – 70%. Obviously, the organization of purification of mine waters to the level of the requirements if not for drinking water, at least for technical water and increasing the share of sea water can serve to stabilize the situation with water.

The distribution of water between the main consumers is constantly changing. Thus, in the period from 2006 to 2012, the share of water used in agriculture increased from 19 to 40% (from 2.6 to 5.7 km^3 per year), and in industry it decreased from 60% to 42% (from 8.6 to 5.9 km^3). The consumption of water in the housing and communal services (HCS) has decreased from 4.1 to 3.1 km^3. This is due both to decreased population (from 46929 thousand in 2006 to 45633 thousand in 2012), and with consumers' attempts to save water.

Distribution of water between the main industries: 66% – electricity; 27% – metallurgy; 2% – chemical industry; 2% – food industry; 3% – others. Total use is 5.9 km^3 per year.

Distribution of desalted water among the main industries: 31% – electric power industry; 31% – metallurgy; 26% – chemical industry; 12% – production of beverages.

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The agriculture uses 5.7 km^3 of water per year, of which 92% are used for irrigation (melioration and gardening) and 8% for agricultural water supply.

Unfortunately, not all the collected water reaches the consumer. On average, up to 20% of water falls to transport losses.

Water losses are 2.3 km^3 per year, whereof: in housing and communal services – 50%; in industry – 25%; in agriculture – 25%.

Water consumption in housing and communal services (km^3 per year): taken – 3.3; supplied to the network – 2.9; implemented – 1.9; losses and expenses – 1.4.

The main water losses in the housing and communal services are due to the unsatisfactory condition of the water supply network; the total length of pipelines is 135,958 km, of which 51,855 km (or 38%) requires urgent replacement. The annual replacement of pipes is carried out in the volume of 1 – 2% of the required one.

The main «producers» of wastewater: agriculture – 12% (0.95 km^3); housing and communal services (HCS) – 27% (2.1 km^3); industry – 61% (4.75 km^3).

Condition of wastewater generated: contaminated – 19% (1.5 km^3); normatively purified – 23% (1.8 km^3); normally clean without treatment – 58% (4.5 km^3).

The main amount of pollution comes from industrial wastewater (61%), only 9% of which is reused. One third of the volume of communal wastewater is discharged untreated.

Water quality. About 15% of the samples examined did not meet the standards for sanitary and chemical parameters, and about 4% - for sanitary and bacteriological indicators.

Of great concern is the condition of rural water pipelines; among tested rural water pipelines – 7.3% do not comply with the rules and regulations. At the same time, only 25% of villages in Ukraine are provided with centralized water supply.

According to experts, the payback period of investments in the city's HCS infrastructure is about 10 years, which means that utility companies need long-term and inexpensive credit resources, at least for the same period.

Not all the necessary equipment is produced in Ukraine, but even in cases when there are competitive domestic analogues or companies that can perform works well and qualitatively, foreign companies are preferred. The same applies to the terms of tenders for project implementation.

The package of documents for receiving HCS financing should be prepared with the involvement of qualified specialists at all levels from the Ministry and local authorities to specialist practitioners of manufacturing enterprises, economists, designers, installers, and others.

The activation of Ukraine's participation in attracting loans from international financial organizations for the reconstruction of HCS utilities is a strategically necessary and objectively important step, but it must be appropriately calculated and prepared.

For cold water in Germany they pay in average 2 €/m^3, in Lithuania – 1.3 €/m^3, in Poland – 1 €/m^3, in Ukraine – 0.4 €/m^3.

Summarizing conclusions on the water economy of Ukraine: water saving; local treatment of wastewater and its maximum re-use; increase in the volume of water used from alternative sources – seas, mines, etc.; use of local systems wherever possible – both for water preparation and post-treatment.

We consciously do not mention the two most radical and correct, but at the same time utopian ways – improvement of the technology of centralized water treatment and rehabilitation of water supply networks. The expensiveness of these solutions and the financial condition of Ukraine in the foreseeable future are unlikely to be compatible. And the remote future is still far distant.

Originality and practical value

«Presence of drugs in drinking water is a terrible environmental threat on a global scale. Pharmaceutical firms do not want even to hear about this problem – they do not want to spend huge money on the development and introduction of drugs that are fully absorbed by the body. But in the next two to three years they will have to listen to the opinion of ecologists and radically change the strategy of production of medicines», the modern ecologist Thomas Turne said (2016) [2].

Thousands of pharmaceutical factories annually launch tens of millions of tons of medicines on the world market. The volume of medicines sales in the world exceeds the volume of oil sales. Until recently, no one thought about their final fate. The

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scientists found that more than half of the medicinal preparations are excreted from the human body in biologically active form and practically do not lose their properties. They come in colossal quantities into sewage and from there to drinking water sources [2].

The international database of chemicals includes 56 million items. Maximum permissible concentrations (MPCs) are defined for only 1% of *potential water pollutants*. While the laboratories that lead control may register even less amounts.

In 2007, German chemists Thomas Heberer and Hans-Jurgen Stan discovered in the groundwaters of Germany and Switzerland significant quantities of a popular in Europe drug for reduction in blood cholesterol. Soon the scientists also found other medicines in rivers, lakes and deep aquifers.

Consequently, each of us uses a medicine box full of high-potent pharmaceutical drugs from the tap every day.

Wastewater treatment plants, as a rule, are not adapted for decomposition or trapping of medicinal products. An effective method for wastewater treatment can be physical and physicochemical methods of purification (ozonation, membrane filtration, reverse osmosis, sorption, etc.). They even offer to create special toilets for cleaning and processing urine in hospitals, outpatient clinics, etc.

Waste medicines and pharmaceuticals are called organic micropollutants (OMP). This group includes pharmaceuticals, personal care products and pesticides, which are in the list of priority pollutants of the US Environmental Protection Agency, and are also of priority for the European Environment Agency.

In 2015, the European Commission developed a control list of substances to be monitored on a European Union scale – EU Directive 2015 (495) of 20 March 2015. The following substances were included in the control list: diclofenac, synthetic (EE2) and natural (E2), hormones (E1), three antibiotics (including erythromycin), a number of pesticides (methiocarb, etc.); antioxidant, which is used as a food additive.

OMP sources are: 1 – industrial wastewater; 2 – agricultural wastewater; 3 – landfills of household waste; 4 – household and hospital wastewater.

The existing wastewater treatment technologies are not designed to remove OMP. Both by physical and chemical characteristics and because of their low content in the treated water.

For example, one of the OMP components is diclofenac, an anti-inflammatory drug that is widely used in surgery, traumatology, sports medicine, neurology, gynecology, urology, oncology and ophthalmology. Experts propose to completely ban it due to an increase (approximately by 40%) of the risk of heart attacks and other cardiovascular diseases in case of long-term ingestion. To purify waters from diclofenac, it is recommended to use a combined method -microfiltration and reverse osmosis.

In conclusion, I would like to note the following: until now in Ukraine the problem of natural waters pollution with OMP has not been considered either at the official or academic levels. In our country there are no normative legal documents that regulate the discharge of these substances into water bodies. According to the Proposal to the Basic Plan for Adaptation of National Environmental Legislation to the Legislation of the European Union, an immediate solution is required to develop and implement scientifically sound standards for the maximum permissible discharge of OMP into surface waters and strict control over their observance.

Foreign water news.

Europe's water economy is estimated according to The Richest, which makes the ratings of the top-10 by a variety of indicators.

Norway occupies the second place in the quality of tap water, second only to Switzerland [8]. The secret lies in the systemic approach to water management – from water intake to wastewater discharge after treatment, which in general is not a secret, but the prescribed truth of the water management textbooks. The recipe for translating theoretical principles into practice begins with the obligatory study of water management by students of engineering specialties who come to water treatment plants, industrial enterprises and local authorities, think not only about how to prepare water to the level of industry standards, but also about how to protect the water environment, reduce the consumption of reagents and electricity, thereby reducing the negative impact on the environment [3, 4].

The officially proclaimed mission of the Norwegian water sector is caring for health and envi-

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ronment. Annually, water treatment plants purify 700 million m^3 of drinking water and the same volume is discharged after treatment. An interesting fact is that there are more sewage treatment plants in the country than water treatment plants. 2,700 stations are in communal ownership and they cover 84% of the population, the remaining 16% use small local wastewater treatment systems, which amount to 330 000. The average water consumption in Norway is 200 liters per day per person. In total, 1,600 water treatment plants operate in the country, providing 90% of the population with water, while the remaining 10% use private wells.

One of the fundamental principles of water management is the exclusion or minimization of waste. So in Norway, all sludge from wastewater treatment plants is used as a safe and effective fertilizer in agriculture and gardening.

Money for the development of water infrastructure comes not from the sale of oil, as some think, but from the municipal budget, which is filled with payments for water supply and sanitation. So, on average, each household pays for water supply and sanitation about 850 euros per year. However, many municipalities already today point out the need to raise water fees, so that future generations would not have to pay tens of times more for water because of the urgent need for capital repairs.

Water management in Norway is a good example of following the methods of water management; the art, which is easy to learn and is a good example of developed countries.

In a small area of Switzerland, there is 6% of freshwater resources in Europe [11]. The average water consumption in Switzerland is 162 l/day per person. The sources of drinking water supply in Switzerland are spring waters – 40%, groundwater – 40%, water of rivers and lakes – 20%.

95% of Swiss citizens drink tap water. The quality and quantity of Switzerland's water resources can only be envied. Therefore, the source of drinking water supply in each case is chosen very carefully. It is interesting that the methods of drinking water disinfection are different in different cities. So, in the cities of Olten and Trimbach, which use only underground water, the latter is decontaminated only with chlorine dioxideIn the nearby village of Dulliken (underground water), ozone is used for disinfection. The city of Oftringen, which uses underground and spring water in the ratio of 90% and 10% respectively, applies ultraviolet.

It is also curious that the amount of water in Switzerland is regulated by the law on food products. This imposes even more stringent requirements and restrictions to be met by the tap water quality. Tap water in Switzerland is equal or even superior in quality of bottled mineral water. In addition, tap water is cheaper. Thus, the average price of tap water is 0.0018 CHF/l, while that of the bottled water is 0.8 CHF/l.

The cost of tap water in different cities of Switzerland varies significantly. The highest tariff is in St. Gallen, about 3 CHF/m^3, and the lowest one in Stans – only 0.5 CHF/m^3.

Water hardness scale in Switzerland: 0 – 0.7 mmol/dm^3 – very soft water; 0.7 – 1.5 mmol/dm^3 – soft water; 1.5 – 2.5 mmol/dm^3 – water of medium hardness; 2.5 – 3.2 mmol/dm^3 – moderately hard water; 3.2 – 4.2 mmol/dm^3 – hard water; More than 4.2 mmol/dm^3 – very hard water.

The Swiss are not only proud of their water quality, but also cherish the water treasure that they inherited. It would be desirable for the people of Ukraine to know about this and follow everything like the Swiss.

Switzerland re-processes almost 100% of the waste. The garbage sorting system here is brought to the absolute and even to the point of absurdity as it may seem to someone. Herewith, the system does not know exceptions – everyone has to throw garbage in different containers. Those who do not agree pay a fine. In Switzerland, [6] there is a so-called environmental police, which, using modern technology, analyzes the garbage left in the wrong place or without paying tax, finds and penalizes an offender. More than 90% of the glass containers are returned to factories for glass recycling. At the same time, only when you return some types of beer bottles to the store you can get a certain reward. In other cases, those who hand over bottles do not receive anything for this. The paper is processed separately from the cardboard. 60% of all batteries sold in Switzerland are recycled and not thrown in the garbage. Separately handed over items are: daylight lamps, cans, PET bottles, household appliances. It is strictly forbidden to

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change the oil in your own car – this should be done at technical stations.

If you want, you can certainly not sort the garbage. In this case, you have to pay the tax, which is collected from each kilogram of waste. For 5 kg of garbage you will have to pay about 2 – 3 francs, but to hand over waste to special points of reception costs nothing. It is worth noting that this was not always the case. In 80-ies of the twentieth century, the environmental situation in Switzerland was disastrous, only to Zurich more than 3,000 tons of waste was brought per day. The first step in solving this environmental puzzle was the introduction of a garbage duty.

As a result, Switzerland is now one of the most environmentally friendly countries in the world, with developed public transport and clean mountain air. One can safely drink water from any lake or tap.

Singapore today is the only country in the world that does not discharge a single liter of sewage [12]. That is, the sewage produced by the city-state is collected, purified and re-used. For example, wastewater purified for drinking purposes and bottled is called «New Water».

In the state of California (USA) for more than 30 years, the joint utility company (Orange County Water District and Orange County Sanitation District) has been operating to produce clean drinking water from urban sewage [18]. The purification system contains three main stages: microfiltration, reverse osmosis, post-treatment by ultraviolet.

The enterprise capacity is 32 thousand m^3/day.

The city of Fukuoka (Japan) was the first to get hydrogen from sewage and use it as a fuel for cars [19]. The station works only 12 hours a day, and the gas produced there is enough to fill 65 cars. At the same time, working at full capacity, the station can provide hydrogen for up to 600 cars per day.

Scientists from the Netherlands proposed the technology of obtaining one of the main components of bioplastics, namely polyhydroxyalkanoate, from wastewater components and spent activated sludge [17].

In Poland, private companies use mussels for drinking water quality monitoring. This is due to the fact that the mussels respond instantly to changes in water quality and are closed, in case it is deteriorated, protecting themselves from the harmful effects of the environment [19]. The system works online and gives the opportunity to respond to emerging water quality problems.

Water and human body. Since school, we have learned the truth that a human is 80% water. However, this value is averaged. For example, in a newborn child, water occupies 80% of the body weight, for a 4-month-old baby it is 93%, for a person in «his/her prime» – 70–75%, and for the elderly – only 60–65%.

Water helps the human body to breathe, carry out thermoregulation and transport of substances.

Loss of 1% of water from body weight reduces human performance, with a loss of 2% a person experiences a strong thirst, loss of 10% can cause syncope and hallucinations, loss of more than 12% is lethal.

It is necessary to drink water as often as possible, each time not more than a glass. The water must be fresh non-carbonated and soft.

The norm for adults is to drink during the day 30 grams of water per kilogram of weight at the outside temperature of 20–25°C, for teens this rate is twice as high.

The production of 1 kg of chocolate requires 24 m^3 of water, 1 kg of meat – 15.5 m^3, 1 kg of sugar – 1.5 m^3, 1 cup of coffee – 140 l.

«Water Footprint» is a term that reflects the amount of water expended in the production of various goods or services. The definition of «water footprint», as a rule, applies to the consumer of water (human, organization, country) and takes into account the source of water consumed, as well as the time and intensity of consumption.

According to the calculations, the «water footprint» of each average inhabitant of the earth is 1,240 m^3 of water per year.

Countries with the lowest «water footprint» include Latvia, Georgia, Hungary, China, Afghanistan, Peru, Congo, Angola and (600 – 1,000 m^3 of water per year per person), the countries with the highest water footprint are the USA, Greece, Malaysia, Russia, Italy, Thailand, Spain, Sudan (2,100 – 2,500 m^3 of water per year per person).

70% of all fresh water withdrawn from the environment by man goes to irrigation of agricultural land.

Specialists note that drinking water contaminated with nitrates when it is consumed is extremely dangerous for infants.

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And can water be carcinogenic? Yes! After water chlorination the gaseous chlorine with the organic part of water form carcinogenic substances.

Desalination of sea water. Reverse osmosis. Climatologists claim that the planet is to be faced with dry years, so already now there is reassessment of traditional water supplies [1]. The population is growing, and with it – the demand for water, which means that new sources of water supply will be needed.

In response to increased water shortages over the past 30 years, desalination has become a viable alternative to traditional sources of water supply. According to the International Desalination Association, more than 17,000 water desalination plants currently operate in 120 countries [13–16, 20]. At the same time, desalination provides only about 1% of the world's drinking water needs, but this proportion grows from year to year.

Desalinated drinking water is obtained either from brackish water (salt content <10 000 mg/l) or from sea water (mineralization from 14 000 to 44 000 mg/l). The total volume of brackish water in the world is limited (<1% of the world's water reserves).

The global ocean contains > 97.2% of the world's water resources. This is 1 330 million km^3 of alternative water in addition to the available 41 thousand km^3 of available fresh water from rivers, lakes and artesian springs. The ocean has its own distinctive features - its resources are virtually unlimited and their extent is not affected by drought and climate change.

More than 50% of the world's population lives in cities bordering the ocean. The group of leaders of the water desalination market in the period of 2010 – 2013 was presented by Saudi Arabia, USA and Australia. Further in this list there are Israel, Kuwait, Libya, the United Arab Emirates, China, India and Chile. According to statistics, the number of desalination centers in these regions is continuously growing at a rate of 7 to 9% per year.

The first thermal desalination plant started operation in the late 1850s on ships for boilers and drinking purposes. Over the past 10 years, desalination with seawater reverse osmosis (SWRO) membranes has dominated all desalination markets, except the Middle East (evaporation is the dominant technology).

Water desalination technologies: 63% – reverse osmosis; 31% – distillation; 3% – electrodialysis; 3% – combined methods.

In the Old World, Spain is of particular interest, as 40 years ago (in 1966) it built the first membrane plant in Europe for sea water desalination on the Canary Islands, and to this day it has been using these technologies most actively among European countries. In that way 40% of the water consumed by the city of Alicante (310 000 inhabitants) located on the Mediterranean coast is provided by membrane desalination plants. Today in Spain there are more than 900 such plants, the total capacity of which is 1.5 million m^3/day and 49% of them desalinate sea water.

One of the key factors in reducing the cost of seawater desalination is the progress of SWRO membrane technology. First of all, this is the emergence of a new generation of low-pressure membranes with an increased surface area, with high resistance to fouling and biological effects.

The world leader in SWRO membrane production is Dow Chemical (USA). This is one of the largest companies that invest in research and development (R&D) in the chemical industry. In 2011, the company invested $ 1.65 billion in innovative development; the staff employed in R&D amounted to 5,500 specialists.

Conclusions

In conclusion, it should be noted that water resources are a strategic issue of all countries of the world, their environmental, economic and energy development and food problems:

– The obtained water quality monitoring data in the regions of Ukraine during the flood period showed that not everything is as bad as one could imagine, and despite the scandalous Internet messaging, the quality of tap water in various cities of Ukraine is in most cases close or meets the requirements for drinking water. However, it is also obvious that tap water in all regions should be additionally purified;

– Imbalance exceeds the value of 10 thousand m^3 per year per person («catastrophic») and is observed in 5 southeastern regions of Ukraine. Also five regions can be considered the «balanced» (less than 1 ths. m^3 per year per person) – four western and one northern region. On the average, Ukraine is in the zone between «permissible» (from 0.1

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to 0.3) and «extraordinary» (1.0 to 2.0) unbalance. In this case, it is necessary to think about alternative sources of water supply (for example, reuse of wastewater, seawater desalination, etc.);

– On average, up to 20% of water falls on transport losses. The main water losses in the HCS are due to the unsatisfactory condition of the water supply network;

– The main amount of pollution comes from industrial wastewater (61%), only 9% of which is reused. One third of the volume of communal wastewater is discharged untreated;

– About 15% of the samples examined did not meet the standards for sanitary and chemical indicators, and about 4% – for sanitary-bacteriological indicators;

– The activation of Ukraine's participation in attracting loans from international financial organizations for the reconstruction of utilities is a strategically necessary and objectively important step, but it must be appropriately calculated and prepared;

– Up to now in Ukraine the problem of natural waters pollution with OMP has not been considered either at the official or academic levels. In our country there are no normative legal documents;

– Water management in Norway is a good example of following the methods of water management; the art, which is easy to learn and is a good example of developed countries;

– In response to increased water shortages over the past 30 years, desalination has become a viable alternative to traditional sources of water supply. According to the International Desalination Association, more than 17,000 water desalination plants currently operate in 120 countries. At the same time, desalination provides only about 1% of the world's drinking water needs, but this proportion grows from year to year.

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ВОДНІ РЕАЛІЇ В УКРАЇНІ ТА СВІТІ

Мета. У статті необхідно проаналізувати стан водного господарства в Україні та світі, а також кращі досягнення в цьому напрямку. **Методика.** Дослідження виконані на підставі аналізу літературних джерел та звітних даних про стан водного господарства в Україні, європейських країнах та США (2010–2016 рр.). **Результати.** Аналіз стану води в регіонах України показав, що її якість у більшості випадків відповідає вимогам для питної води або близька до них, але потрібне доочищення питної води, що надходить у водопровід, в усіх регіонах країни. Основним питанням на сьогоднішній день є виробництво необхідного обладнання для очисних споруд. На жаль, не все обладнання виготовляється в Україні. Стан сільських водопроводів викликає особливе занепокоєння. З перевірених водопроводів – 7,3 % не відповідають нормам та правилам. У той же час централізованим водопостачанням забезпечено лише 25 % сіл України. **Наукова новизна**. Авторами представлені результати комплексного розгляду питань знезараження питної та стічної вод, де використовуються різні методи, частково в комбінуванні один із одним (реалії України та світу). Головним, невирішеним на сьогоднішній день, є питання залишкової кількості ліків, що потрапляють у питну воду. Основна екологічна загроза світового масштабу в питній воді – наявність ліків. Очисні споруди не пристосовані для розкладання або виявлення лікарських засобів. У всьому світі ніде не передбачена боротьба з цими речовинами. Одним із ключових питань вирішення проблеми видобутку питної води є опріснення морської води. Для зниження вартості опріснення морської води використовуються технології SWRO-мембран. **Практична значимість.** Водні проблеми є проблемами номер один у всьому світі, й в Україні в тому числі. Потрібно передбачити додаткове фінансування для вирішення проблем підготовки та очищення вод, не за залишковим принципом, а з огляду на те, що вода – це основа життя на землі та в цілому від якості джерела водопостачання залежить здоров'я та життя нації.

Ключові слова: очистка стічних і питних вод; ліки в стічних водах; нові джерела питної води; знезараження стічної та питної вод; опріснювальні установки; отримання прісної води з морів.

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ВОДНЫЕ РЕАЛИИ В УКРАИНЕ И МИРЕ

Цель. В статье необходимо проанализировать состояние водного хозяйства в Украине и мире, а также лучшие достижения в этом направлении**. Методика.** Исследования выполнены на основании анализа литературных источников и отчетных данных о состоянии водного хозяйства в Украине, европейских странах, США (2010–2016 гг.). **Результаты.** Анализ состояния воды в регионах Украины показал, что ее качество в большинстве случаев соответствует требованиям для питьевой воды или близки к ним, но необходима доочистка питьевой воды, поступающей в водопровод, во всех регионах страны. Основным вопросом на сегодняшний день является производство необходимого оборудования для очистных сооружений. К сожалению, не всё оборудование производится в Украине. Состояние сельских водопроводов вызывает особенное беспокойство. Из проверенных водопроводов – 7,3 % не соответствуют нормам и правилам. В то же время централизованным водоснабжением обеспечено только 25 % сел Украины. **Научная новизна.** Авторами представлены результаты комплексного рассмотрения вопросов по обеззараживанию питьевой и сточной вод, где используются различные методы, частично в комбинировании друг с другом (реалии Украины и мира). Основным, нерешённым на сегодняшний день, является вопрос остаточного количества лекарств, попадающих в питьевую воду. Основная экологическая угроза мирового масштаба в питьевой воде – наличие лекарств. Очистные сооружения не приспособлены для разложения или обнаружения лекарственных средств. Во всем мире нигде не предусмотрена борьба с данными веществами. Одним из ключевых вопросов решения проблемы добычи питьевой воды является опреснение морской воды. Для снижения стоимости опреснения морской воды используются технологии SWRO-мембран. **Практическая значимость.** Водные проблемы являются проблемами номер один во всем мире, и в Украине в том числе. Нужно предусмотреть дополнительное финансирование для решения проблем подготовки и очистки вод, не по остаточному принципу, а учитывая то, что вода – это основа жизни на земле и в целом от качества источника водоснабжения зависит здоровье и жизнь нации.

Ключевые слова: очистка сточных и питьевых вод; лекарства в сточных водах; новые источники питьевой воды; обеззараживание сточной и питьевой вод; опреснительные установки; получение пресной воды из морей

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