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TRANSPORT INFLUENCE ON THE ENVIRONMENTAL STATE OF WATER RESERVOIRS

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Abstract. In this paper the negative influence of transport on the environment has been analyzed, specifically impact on groundwater and drinking water was estimated. A comparison of the technologies and methods of water treatment from harmful chemicals in Ukraine and Lithuania were presented, as well as the requirements for drinking water in Ukraine and Lithuania were analyzed.

Keywords: transport, pollution, water treatment, drinking water quality

Introduction

Transportation, in all its forms, is a key of component of the current development process. Unfortunately, transport development is associated with a wide diversity of, mostly, negative impacts. If transportation is considered as a system, this implies associating six subsystems, consisting of air transport, road, railway water, underground and pipeline. The current desiderate is to provide sustainable development for these transport subsystems (Condurat, Mihaela *et al.* 2017).

Problem statement

Transport is one of the strong sources of pollution of the atmosphere, litosphere and hydrosphere. Exhausts containing dangerous substances for the environment settle on the roads and together with rainwater penetrate into the layers of the lithosphere. After that, dirty water containing oil, heavy metals, aldehydes and soot, etc. gets into groundwater, which is a source of fresh water in many countries, including Ukraine and Lithuania.

As known, hydrosphere consists of surface and groundwater, that’s why is so important to reduce the negative impact of transport on the hydrosphere. So, taking into account that the drink water is a main factor of comfortable life of people, over 97% is salty water and 3% is fresh water, there are three main keys for surface and groundwater protection:

- ♦ waste reduction;
- ♦ waste recycling
- ♦ development of cleaning technologies.

The main goal of this work is to analyze transport impact on the water reservoirs and to compare the water treatment standards in Ukraine with European standards.

Transport as a contaminative source

Transportation projects can have significant effects on water quality. Motor vehicles, for example, deposit particles of rubber, oil, and other pollutants on roads; when it rains, these pollutants washed into the areas around the road. In some cases, the storm water may flow through drains directly to a river, lake, or bay or it may contaminate groundwater or the water in a wetland area. Impacts can be lessened by diverting storm water away from sensitive habitats or into sewer systems that treat the water before discharge into waterways. The land use impacts of transportation projects can also affect water quality and availability by making the ground less permeable, thus increasing runoff (Transportation and water quality; no data). On the Fig. 1 presented the transport negative impact on the water quality.

According to the Environmental Protection Agency (EPA), 85% of motor oil, which car owners change independently, is not properly discharging into the sewers, garbage cans, and to the ground. At the same time, used engine oil can become one of the largest sources of pollution of groundwater and watercourses. The likely consequences are amazing: a liter of oil can become a source of oil stains with an area of almost 1 hectare or contaminate a million liters of drinking water (Qing, Gu; *et al.* 2014; Влияние моторных масел … no data).

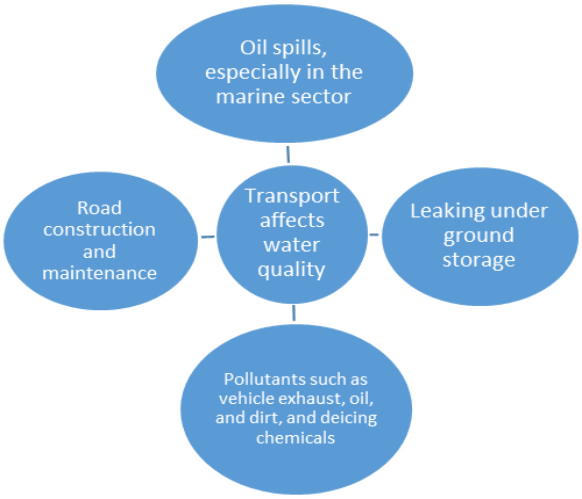

Fig. 1. Transportation Affects Water Quality.

So, the direct impact of various types of transport on the hydrosphere is presented in the Table 1.

Table 1. Analysis of transport impact on the hydrosphere.

Kind of Transport	**Type of Pollution**
Water	Waste of operational activity
	Emergency spills of toxic cargo
	Drainage of ballast water
	Washing of tanks for removal of previously carried cargo
Road	Rainout of chemical compounds being released into the atmosphere
	Recycling of used lubricants
	Recycling of waste tires
Air	Oil spills at the airport
	Aircraft refueling
	Aircraft treatment by de-icing & anti-icing liquids
Railway	Transportation of bulk cargoes (ore, coal, etc.)
	Emergences
Pipeline	Unauthorized oil, ammonia, petrol spills

The most dangerous impact of all transportation form is connected with transportation of dangerous cargo and emergencies of toxic substances spills**.**

Water Quality Analysis in Ukraine

Drinking water can be called water that does not harm human health and is also purified using special water treatment equipment in accordance with established standards. Among the main indicators of drinking water quality are:

- mechanical pollution;
- organoleptic;
- chemical;
- bacteriological, virological, parasitic;
- radiological.

The main difference and guarantor of the quality of drinking water is the low salt content, as well as standards and quality standards for composition and properties.

To a greater extent, Ukrainians receive approximately 80% of fresh water from a surface water source, while in more developed countries for water treatment, 80% of drinking water is obtained from underground sources. Unfortunately, a huge amount of waste, such as sewage, household and industrial waste, rain, pesticides, nitrates and nitrites, salts of heavy metals, etc., are discharging into almost all rivers of Ukraine.

Transport is considering one of the main pollutants. 16 cities of Ukraine recognized as one of the most polluted (topped the list of Mariupol and Dnipro) because of road transport. Components found in combustion products (sulfur dioxide, dust, formaldehyde) have a detrimental effect on the environment, in humans cause severe respiratory diseases, as well as when ingested poison the body and affect cells. With the help of runoff, contaminated water enters the upper layers of water, which Ukraine uses as fresh water reserves. This water used for domestic and industrial purposes. Unfortunately, water from taps in residential buildings can have poisons, as it needs better and new cleaning methods. At water purification stations, reagent and non-reagent methods of water treatment are used. Coagulant (aluminum sulfate), flocculants (activated silicic acid, polyacrylamide, etc.) are using for the reagent, which accelerates coagulation and helps to illuminate and discolor. However, with the reagent method in water an undesirable amount of dissolved aluminum salts remains. At the same time, the water is acidifying with poisonous sulfuric acid released during the hydrolysis of aluminum sulfate. We produce it by a non-reagent method. After sedimentation tanks, water filters applied with a layer of sand or anthracite, and disinfected with chlorine, this is the oldest and cheapest method. It leads to additional pollution of drinking water with free and residual chlorine, hydrogen chloride and organochlorine.

The most polluted water in the central and eastern parts of Ukraine, where the centers of heavy industry are concentrated. Especially polluted water in the cities of Luhansk, Donetsk, Dnipro, Kryvyi Rih. According to the analysis, these waters contain harmful impurities that deviate from the norm by 80%. As a result, outbreaks of infections, hepatitis A and even typhoid fever were recording. In the above areas, drinking water sources - wells (depth up to 30 metro) are also unsuitable for use. Due to poor water quality residents of Kyiv, Kharkov, Donetsk, Luhansk, etc. forced to buy purified and softer water, use water from pump rooms, etc. However, these sources are also not suitable for use, because they have a high indicator of iron impurity, hydrogen sulfide concentration (as evidenced by the smell and color of water) and lead (Очистка стоков: "почки"… 2018).

In addition, a direct confirmation of the poor quality of water in Ukraine is the precipitate that forms in teapots when boiling water. With direct use of water (pouring into a container), a cloudy color and a specific smell of chlorine are observing, as well as small particles of this substance are observing.

In 2017, the enterprises of the water supply and sewer system processed 1.57 billion cubic meters of runoff water, of which 95% were treated. Most of the treated water falls into cities, since in about 95% of villages there is no sewage system. All treatment facilities were build 50-70 years ago with a norm of operation of 50 years. Almost all water treatment plants in Ukraine are under reconstruction. To improve the quality of drinking water, as well as fresh water, all stations need new equipment, because the original one is in critical condition.

Unfortunately, now huge amounts of chemicals are sold in household chemicals and actually cannot be cleaned fall into the effluent, thereby polluting the hydrosphere. A major hazard to groundwater is car washes, gas stations, restaurants, etc. Only machine detergent contains methanol, mineral oil distillate and phosphates.

Phosphates pose a great threat to the environment. Once in the water, phosphates contribute to the reproduction of blue-green algae. Blue-green algae cover the surface of reservoirs with a film that prevents the entry of oxygen and sunlight into the water. When decomposed, algae release large amounts of methane, ammonia, hydrogen sulfide into the water, killing everything living in water bodies. One gram of tripolyphosphates contributes to the growth of five to ten kilograms of blue-green algae (Фосфаты и их влияние ... no data).

The largest wastewater treatment plant in Ukraine is the Bortnic aeration station. The station purifies the drainage water not only of the capital, but also of nearby cities. Three treatment units were building in 1960-1980, so most of the equipment is not suitable for operation (about 80%).

The Japan International Cooperation Agency (JICA) in the conditions of 0.1% provided a loan for the reconstruction of BSA for 108 billion yen per annum for 40 years with a 10-year “vacation”.

Now the reconstruction of BSA is one of the largest infrastructure projects in Ukraine, after which the quality of treated wastewater will be monitored with 10 indicators and comply with EU standards (Очистка стоков: "почки" наших ... 2018).

Water Quality Analysis in Lithuania

For comparison, we give an example of one of the closest European countries is Lithuania, and cleaning methods and water quality in this country.

Researchers at Kaunas University of Technology are developing new disinfection technology, which destroys microorganisms, provides a long-term of protection and not harmful for users. This technology not only efficiently destroys the microbes existing in the water, but the treated water protected from secondary microbial contamination: microbes do not breed in openly kept water containers for more than several months (Lithuania a leading EU… 2013).

The water disinfection technology based on different water treatment methods. One of active ingredients in the water treatment process is silver. This active ingredient helps water purified and does not disappear from the water over a long period, helps to maintain purity and does not allow microorganisms to develop.

In Lithuania, we have an abundant supply of drinking water, its chemical and microbiological characteristics are good. However, this is not the case in many countries, particularly in the developing world. Cost-efficient drinking water purification technologies are critical for water supply companies, for bottled water industry and for individual users who have limited access to water supply, or when tap water contaminated by microorganisms (Lithuanian Water Partnership, 2002).

The primary water collection system in Lithuania is 100% compliant with the requirements of the European Union, and secondary and tertiary treatment comply with 98% and 85% of EU laws, which makes Lithuania one of the leaders in wastewater treatment. In 2012, 93% of all wastewater in Lithuania was completely treating, while insufficiently treated water amounted to 7%. In 2002, 21% were recognizing as treated waters in Lithuania. While in Ukraine in 2002 approximately 10% was cleared, and in 2018 the percentage increased to 80% (Fig. 2).

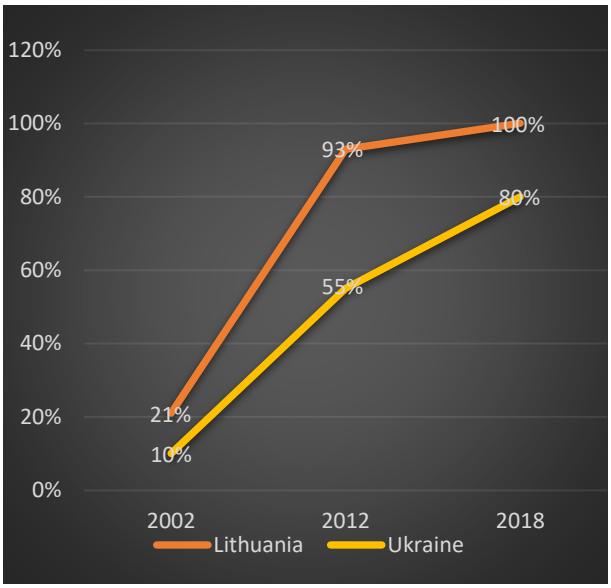

Fig.2. Water Quality Improvement.

For a complete comparison and description of the situation in water treatment in Ukraine, we presented table 2 with acceptable standards approved by the World Health Organization, the European Union and Ukraine (Нормативы на питьевую воду, 2017).

As we can see from the table 2, Ukraine has a big discrepancy between water treatment standards and European ones. Many factors affect the water quality; however, the most relevant of them are saving on cleaning materials, cheap equipment, non-compliance with freshwater pollution standards, lack of desire to change legislation, etc.

Table 2. Comparison acceptable standards.

Indicators	Units	Ukraine (MCL*)	WHO (MCL*)	The EU (MPC*, no more)
Hydrogen indicator	pH	6-9	-	6.5-8.5
Total mineralization (solids)	Mg/l	1,000 - 1,500	1,000	1,500
Total hardness	mEq / L	7.0 (10)	-	1.2
Permanganate oxidation	Mg/l	5.0	-	5.0
Petroleum products, total	Mg/l	0.1	-	-
Surfactants, anionic	Mg/l	0.5	-	-
Phenolic index	Mg/l	0.25	-	-
Alkalinity	Mg HCO_3/l	-	-	30.0
Aluminum	Mg/l	0.5	0.2	0.2
Ammonium nitrogen	Mg/l	2.0	1.5	0.5
Asbest	Mill.fiber/l	-	-	-
Barium	Mg/l	0.1	0.7	0.1
Beryllium	Mg/l	0.0002	-	-
Boron	Mg/l	0.5	0.3	0.1
Vanadium	Mg/l	0.1	0.1	-
Bismuth	Mg/l	0.1	0.1	-
Iron	Mg/l	0.3-10	0.3	0.2
Cadmium	Mg/l	0.001	0.003	0.005
Potassium	Mg/l	-	-	12.0
Calcium	Mg/l	-	-	100.0
Cobalt	Mg/l	0.1	-	-
Silicon	Mg/l	10.0	-	-
Magnesium	Mg/l	-	-	50.0
Manganese	Mg/l	0.1 (0.5)	0.5 (0.1)	0.05
Copper	Mg/l	1.0	2.0 (1.0)	2.0
Molybdenum	Mg/l	0.25	0.07	-
Arsenic	Mg/l	0.05	0.01	0.01
Nickel	Mg/l	0.1	-	-
Nitrates	Mg/l	45.0	50.0	50.0
Nitrite	Mg/l	3.0	3.0	0.5
Mercury	Mg/l	0.005	0.001	0.001
Lead	Mg/l	0.03	0.01	0.01
Selenium	Mg/l	0.01	0.01	0.01
Silver	Mg/l	0.05	-	0.01
Hydrogen sulfide	Mg/l	0.03	0.05	-
Strontium	Mg/l	7.0	-	-
Sulfates	Mg/l	500	250	250
Chlorides	Mg/l	350	250	250
Chromium (Cr3 +)	Mg/l	0.5	-	-
Chromium (Cr6 +)	Mg/l	0.05	0.05	0.05
Cyanides	Mg/l	0.035	0.07	0.05
Zinc	Mg/l	5.0	3.0	5.0

MCL* – maximum concentration limit.

Conclusions

Transport is a necessary sphere of human life, which adversely affects the quality of the environment and has many pros and cons.

The most dangerous impact of all transport form is connected with transportation of dangerous cargo and emergencies of toxic substances spills.

Due to comparison of water treatment technologies should be noted that in Lithuania the most widespread method is biological treatment with the help of microorganisms at the same time in Ukraine are chemical methods using by coagulants and flocculants. As a result Ukraine has a big discrepancy between water treatment standards and European ones.

To clean up the environment, in particular water resources, Ukraine needs to invest resources in development and improvement methods and equipment of water treatment plants, tighten regulations and create laws governing this area.

It is necessary to continue scientific research for water quality improvement for each country in the world.

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