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FEATURES OF WATER SUPPLY INEXTREME CONDITIONS

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Abstract *The russian invasion of Ukraine on February 2022, caused mass civilian casualties, damage to infrastructure and production assets, and significantly reduced the reliability of water supply and water quality. It is proposed to use an alternative source of water supply and install a water treatment plant in the basements of buildings. This solution will help reduce the stress and risks associated with interruptions in the supply of drinking water and can be adapted to any residential infrastructure facility by appropriately adjusting the water treatment technology, as well as adjusting the performance and volume of the storage tank.*

Keywords:*water supply, war, water quality, water supply reliability, alternative sources, security, duplex system*

The war in Ukraine has already caused serious damage to the country's water resources, and continues to have a devastating effect, causing a deterioration in the quality of water in surface springs that serve as sources of water supply, and causing long-term environmental risks.

In particular, we can distinguish direct and indirect consequences of hostilities on the territory of Ukraine.

Direct consequences include direct pollution of water bodies, destruction of infrastructure. Important water infrastructure facilities were damaged or destroyed due to shelling and air strikes, which led to the entry of untreated wastewater into water bodies. The destruction of oil depots and pipelines led to the leakage of large amounts of oil and diesel fuel into water bodies (Kharkiv, February 2024). Strikes on dams and land reclamation systems led to the destruction of natural water ecosystems, which negatively affected the state of water resources. In particular, the largest terrorist act committed by russia during the years of the invasion was the destruction of the Kakhovka hydroelectric power station dam. The estimated amount of environmental damage caused by this was almost 4 billion euros.. More than 700,000 people have been left without access to water. The consequences for the economy and the environment will be felt in the long term [1].

On the night of June 6, 2023, the Russian military blew up the engine room of the Kakhovka hydroelectric power station, causing water from the Kakhovka reservoir to

rush downstream into the Dnipro River [2]. Tens of thousands of people, 80 settlements, and the city of Kherson were at risk of flooding.

The loss of the Kakhovka Reservoir significantly reduced the reliability and availability of water supply for the population of the southern and central regions of Ukraine.

In Mariupol, with the beginning of a full-scale war, the water infrastructure was deliberately destroyed, the population was cut off from centralized water supply, which led to a disaster, and even cases of cholera were recorded.

In Ukraine, approximately 70% of consumers use surface water sources, so it is important to provide alternative water supply methods in the event of a serious accident in the water supply system or a failure caused by another russian attack.

Purification of natural waters at most water treatment plants is limited to the removal of suspended particles and colloids from the water, as well as its disinfection by chlorination. These technologies are well-established and relatively inexpensive.

One of the promising ways to solve the problem of providing the population with high-quality drinking water during the period of liquidation of accidents or temporary deterioration of water quality in natural sources used as the main sources of water supply is to use reserves of fresh groundwater, in particular artesian, and supply them through a duplex system.

Studies, the results of which will be presented below, show that with centralized water supply, the average water consumption per person is approximately 320 liters per day. Of this volume, only 10-15 liters, or approximately 5%, is directed to human physiological needs. Thus, the use of valuable reserves of fresh groundwater for domestic purposes, which additionally require complex water treatment measures, is irrational and economically inexpedient.

A solution to this problem could be a dual water supply system, which involves dividing water into two categories:

- for drinking purposes
- for household use.

This approach will increase the reliability and quality of water supply, optimize resource consumption and reduce the burden on natural sources.

To assess the adequacy of installing a duplex water supply system, a mixed survey (filling out online Google forms and oral survey) of the population was conducted. The questionnaire and the results of data processing with visualization are presented in Table 1 and Figure 1, respectively.

Table 1– Questionnaire-survey on the justification of the use of a duplex water supply system.

Question number	Dual water supply system	Absolutely agree	Agree	I don't know.	Disagree	Absolutely disagree
1	The total amount of water I consume per day is approximately 350 liters.					
2	For drinking purposes I spend approximately 5% of the total amount of water					
3	Water quality is the number one priority in water supply reliability.					

Data analysis was performed using the Likert Scale.

Taking into account the results of the surveys and the current situation, the possibility of using a duplex water treatment system and its accumulation in the basements of existing buildings should be assessed. The water treatment plant should be located in a specially equipped room that meets safety and operation requirements. Its installation location should be separated by a special partition or screen for isolation from other technical equipment

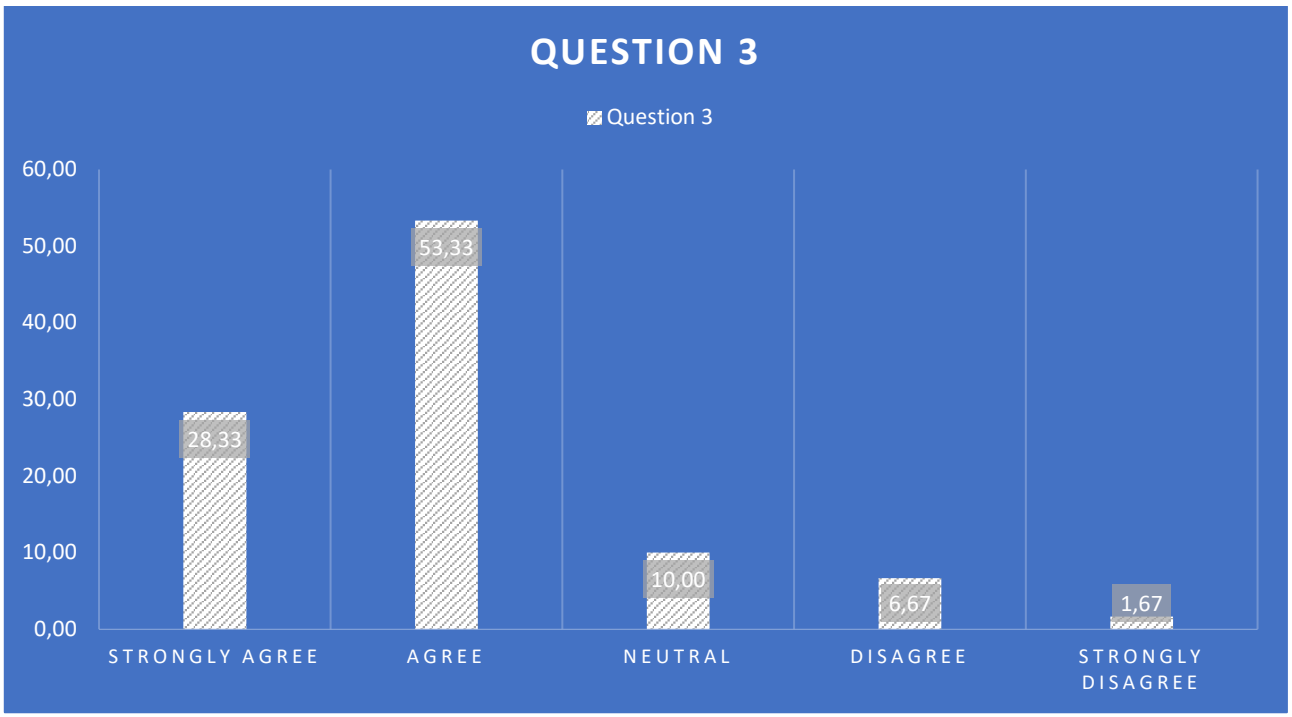

Figure 1– Result of processing question 3

The installation must perform the cleaning function andensure a continuous supply of purified water to all consumers in the house. Purified water is supplied to users through riser B0, which is defined as "drinking water", while water for household needs is transported through a separate pipeline B1.

The installation must also be equipped with a storage tank, which will accumulate purified water in the absence of maximum water consumption (night hours). The volume of the storage tank is selected depending on the number of residents and the volume of water planned for each resident.

To improve the quality of drinking water, we select a 3-stage filter (BIG BLUE Raifil), with which we stabilize the quality of water according to such parameters as the presence of chlorine, suspended solids, taste and smell of chlorine. In particular, the use of a 3-stage filter will stabilize the quality of water according to the main problematic indicators:

The 1st stage is a polypropylene filter 10-15 microns, which will allow you to control the amount of suspended solids, the 2nd stage is a filter filled with granulated carbon, which will allow you to improve the quality of water in terms of organoleptic indicators (taste, smell) and minimize the negative impact of organochlorine

compounds. The final, control stage is represented by a cartridge made of pressed carbon (holes - 10 microns).

The proposed system can be used in any residential infrastructure facility with appropriate adjustments to the number and filling of purification stages, productivity, and storage tank capacity.

The use of a filtering unit in such a configuration will ensure stabilization of the quality characteristics of water from centralized water supply, reduce the negative impact of secondary pollution, and also eliminate the consequences of exceeding permissible levels of pollution by suspended substances, in particular rust particles, which may appear after forced water supply stops due to accidents, blackouts, etc.

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