Intensification of water management during climate change

F Ondrasik¹, S Krocova¹ and A Thomitzek¹

¹VSB-Technical University of Ostrava, Faculty of Safety Engineering, Lumiřova 13, 1875, 703 00 Ostrava-Vyskovice, Czech Republic

Abstract. The current management of the world's fresh water resources is not optimal. Due to the uneven distribution of water, many parts of the world are entering a passive water management balance due to climate change and the growth of the human population. The Czech Republic is one of the countries with a passive balance. With ongoing climate change, it will be difficult in many regions to maintain sufficient raw water for technological and technical purposes without intensification in the water management process. Scientific progress and current technical possibilities offer ways to increase the way water is treated and the possibilities of re-using the realized water in the area of its use for various purposes, from the water source to the final cycle. One of these possibilities and the way of intensive use of water is dealt with in the following article.

1. Introduction

Fresh water management is gaining in importance worldwide. Merely not wasting this medium in everyday civic life or in use for agricultural, technological and sanitary purposes is far from sufficient, especially for the following reasons:

- rapid growth of the human population,
- incoming climate hydrological change,
- depletion of stocks, especially groundwater,
- slow and uneven recovery of water supplies in shallow and deep soil layers.

The above basic and other causes can be summarized as follows. By 2050, about 3.2 billion people will face a shortage of drinking water, warns a new UN report. Global climate change will have a significant impact on water supplies, which may decline by up to 60% over the next 30 years, with the current trend of population growth [1]. However, the paradox remains the fact that the total volume of fresh water on earth far exceeds human requirements. Of the total water resources on earth, 97% is ocean water, the remaining 3% for direct use. Of these 3%, it is estimated at one hundredth for direct human use. Uneven distribution of water in time and space affects the use of water in different geographical areas. Biological survival remains one of the key factors in water use. Many parts of the world are affected by acute water shortages, excessive use of water resources, high levels of pollution caused mainly by anthropogenic influences. Increasing urbanization and industrialization with increased water demand will almost certainly affect most regions of the Czech Republic. Will humanity have enough water resources to secure rising global living standards, to sustain human activity? [2, 12]. Global policymakers are considering reusing wastewater as a suitable alternative source for replenishing freshwater resources. Every day, new worrying reports are brought to the attention of the growing problems of water scarcity in various parts of the world. It is time to look for a solution [3, 13].
2. Assessment and extent of climatic and hydrological threats in the Czech Republic
Considering the current state of the climate, it can be assumed that without a relatively rapid change in water management, the situation will become very serious or even unbearable during this century. One way to respond to these threats is to analyze the underlying threats and their extent. In the Czech Republic, it is necessary to evaluate in the first step a gradual but constant increase in the average annual temperature while comparing the average annual precipitation, see Figure 1 and 2.

![Figure 1. Comparison of average annual temperature [7].](image1)

![Figure 2. Comparison of average annual precipitation [7].](image2)

It is clear from the pictures that the hydrological situation in water management is changing rapidly. In a short time of several, max. Decades, it will be necessary to look for new sources of fresh water for implementation in aquatic ecosystems.

2.1. Hydrological and real threats of water shortage to be implemented
Due to the general lack of water, in the future it will be necessary to use treated water from wastewater treatment plants (hereinafter WWTP) no only as technological water but also for drinking use. Water reuse is a new technology that has not yet been fully implemented (Czech Republic) and is widely discussed. The main obstacle in the use of purified water is an understandable psychological barrier or conflict and disgust. A logical fact based on the lack of basic knowledge of new introduced wastewater treatment technologies. Educating potential users to understand wastewater conversion processes should be a key goal to achieve and enforce this difficult goal [8].
2.2. Wastewater use - a new challenge for humanity

The reuse of water as a planned activity began about 100 years ago when used to irrigate Golden Gate Park in San Francisco, California. Since then, the possibilities of applying water reuse have significantly expanded and increased, from irrigation of urban greenery to food crops, use in the form of thermoregulating cooling water, use in car washing or in fire protection systems. Likewise, the use of industrial wastewater as a substitute for pure primary water in new types of cement composites [4, 5].

Wastewater treatment research has the potential to promote safe, reliable and cost-effective wastewater reuse technologies with a transnational priority [6]. There are several factors leading humanity to use purified water, in addition to the scarcity and permanent loss of quality water, it is also the ongoing significant climate change.

The main obstacle in the use of purified water is an understandable psychological barrier or conflict and disgust. A logical fact based on the lack of basic knowledge of new introduced wastewater treatment technologies [8]. In 2020, a questionnaire was held across the members of the Fire and Rescue Service of the Czech Republic on the possibilities of using treated wastewater for the activities of units. Most respondents had not heard of the possibility of using recycled water before.

3. Survey of the use of treated wastewater by units of the Fire and Rescue Service

The study on the use of treated wastewater addressed members of the fire brigade at the leading levels of intervention commanders or management officers with questions about the use of treated wastewater. The survey was attended by 62 respondents across the Czech Republic from among the members of the Fire and Rescue Service and the Railway Administration - Fire and Rescue Service. The evaluation of the survey showed that the majority of members adhere to the conservative direction when using water resources and 95% choose the hydrant network as a source of providing fire water and replenishment upon arrival at the home base.

![Figure 3. The idea of using water from a WWTP.](image)

Less than a one fifth of respondents have considered the possibility of using treated wastewater, see the Figure 3. Over 66% of respondents do not think that water from the WWTP has worse parameters than water in the recipient and 93.5% are not concerned about the use of purified water from the WWTP from environmental damage. Concerns about the infection during the handling of this water were expressed by over 37% of respondents, see Figure 4. As the light in the future can be seen the fact that over 74% of them would use the treated water from WWTP, if this use was treated legislatively, see Figure 5. The main reason for the use of water from the WWTP respondents state the saving of drinking water, availability, economic aspect and environmental protection.
Is it possible to change this approach and the thinking that has been instilled in members for many years? Idea that water resources are not inexhaustible and will always be available, such as air or sunlight is more or less a bit naive. Either we can prepare for a crisis approaching by leaps and bounds in time before it strikes in full force, or we can accept the consequences of our inaction [3].

4. Preparing for the hydrological crisis of the new age

One of the ways to respond to the situation is to gradually prepare the next generation for the possibility of using these alternative sources in the form of treated wastewater or captured rainwater. As already mentioned above, the units of the Fire and Rescue Service of the Czech Republic mainly use water from the hydrant network in their intervention activities. According to the standard ČSN 752411 Sources of fire water [9], this water should preferably be provided from sources of natural origin, or from multipurpose sources. Using a hydrant network is fast, simple, mostly problem-free (apart from pressure or capacity drops in some localities) without the need to search and think. Ultimately, however, both economic and environmental aspects and pressures are ignored. Many of us take a very lax approach to "saying," "water is the basis of life." In a civilized part of the world, we take water for something granted, as a trade commodity - I will pay and get it [10]. The increase in demand in the EU significantly affects its availability, where this factor is directly proportional to the growing population and the growth of urbanization. The UN sees the reason for the lack of water in its physical scarcity and insufficient access to water due to the failure of institutions ensuring its regular supply to the population and the absence of adequate infrastructure.

Lack of water affects all continents across the planet. The UN in its 2018 report states that up to 2 billion people on the planet are experiencing high water stress [2]. Increased demand for water logically puts increased pressure on existing water resources, leading to a loss of water resources. This situation is significantly exacerbated by ongoing climate change and related effects such as drought or floods. In these situations, water systems fail due to uneven rainfall distribution and anthropogenic influences.

Other factors that influence people's perceptions of water reuse include their level of education, technical awareness, as well as the significant influence of religion and cultural practices.
Misinformation and lack of knowledge or instinctive disgust also have some influence in decision making [11].

5. Conclusion
The problem of water has resonated with society for more than half a century. In the context of the climate change that is taking place, there is currently a great shortage of quality water. Wastewater in the concept of studies is understood as an alternative source of fire water, which is somewhat damned or its use raises some concerns. Due to the general lack of water, in the future it will be necessary to use treated water from wastewater treatment plants (hereinafter WWTP) no only as technological water but also for drinking use. Water reuse is a new technology that has not yet been fully implemented (Czech Republic) and is widely discussed. The main obstacle in the use of purified water is an understandable psychological barrier or conflict and disgust [8]. With regard to climatic and hydrological changes, when the flow rates in rivers are changing depending on rainfall, their frequency and intensity, the levels recede from the banks with the impossibility of building a pumping station, or the quality of the terrain does not allow access to the watercourse, urban wastewater treatment plants are the place where fire water can be pumped without major problems to manage fire interventions. One of the ways to respond to the situation is to gradually prepare the next generation for the possibility of using these alternative sources in the form of treated wastewater or captured rainwater. Environmental protection should be a priority of state authorities and the Fire and Rescue Service of the Czech Republic, which is one of the leading institutions, therefore the use of water in harmony with nature is an important task in this area and the Fire and Rescue Service of the Czech Republic should be a leader. By using the treated wastewater by fire brigades, the operating costs of the organization or municipality would be reduced (for example, in the training of firefighters), increase prestige, including a positive image of the fire brigade.

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