

Pools and surface waters for recreation and sport

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Abstract: In this paper the authors present some aspects of security measures to be taken when used, for recreational or competitive sports, swimming pools or surface water, in terms of their potential pathogen. They are presented aspects of proper pool maintenance. It places special emphasis on ways to maintain water quality during use and mentioned major diseases that threaten users where this is not appropriate maintenance. In this context it is presented also health hazards of surface water, rivers or lakes, which are also used for recreation and sport. The paper will not refer to pools and ponds used in medical treatments and coastal waters.

Keywords: pools, swimming pools, sports, recreation, pathogenic potential, water disinfection

1. INTRODUCTION

Water sports and aquatic sports are individual or team sports which are practiced on water, in water or underwater. Depending on where to practice aquatic sports can be carried out in the pool, running water natural or artificial, natural or artificial lakes, seas and oceans.

Under this definition, water sports can be grouped into two categories, swimming, where people are in direct contact with water, and sports that require a craft.

Lidos and swimming pools are constructions and installations arranged outdoors or in enclosed spaces covered, intended for recreation activities and for performance sports. The quality of water in these pools is influenced by number of users, how are respected the hygiene and sanitary provisions, but also how they are operated and maintained buildings and related installations.

Swimming is a popular sport practiced for both relaxing and performance. It is also recommended for people with different affections, helping to increase lung capacity, improve breathing in general or to a better coordination of movements. In schools that have the necessary equipment, swimming is part of the curriculum. Swimming practice both in pools and in surface water, the swimmer is in direct contact with water, being at risk.

2. POOLS FOR RECREATION AND SPORT

The pools are no longer only in sports bases, recreation bases or big hotels. Currently, many family homes are equipped with swimming pools, even if they are small.

2.1. FILLING AND EMPTYING POOLS

Filling swimming pools, in most cases, it makes with drinking water from public water supply network. This water quality meeting the highest standards. The volume of water it takes to fill a swimming pool is a significant amount of water for the beneficiary, i.e. the volume of all pools of water across a locality can create problems in the public water supply. Therefore the necessary operating rules, to be agreed by mutual agreement between the beneficiary and the provider of water [1]:

- Water supply pool will be made only by the beneficiary branch, the volume of water being metered properly [1];
- It is forbidden to supply water to the pool through public hydrants [1];
- Recommend to fill the pool in night hours when public water consumption is minimal [1];
- It will avoid duplication anyway filling over peak consumption [1];
- In the case of large volumes, it may have a flow limitation in the filling plant, which leads to an increase in the filling time, but at a lower request of the public network;
- When large volumes of water required for the entire village, water and sewerage operator may produce program filler that will be respected by all beneficiaries [1];
- Will be analyzed and alternative sources of water, if any, (egg own wells with water quality, spring intake, others);
- Not least, bear in mind when it planned to construct a swimming pool, an appropriate sizing of branch water.

When emptying pools will take into account the volume of water that will be discharged and the rate at which it will do so. And in this situation water and sewerage operator may draw up a program of emptying if the volume for the entire locality is very high. After use, the water from swimming pools can be used for other uses, for example irrigation.

2.2. WATER QUALITY IN POOLS

Whether the pool is used for performance sports or just for recreation, whether covered or uncovered pool, pool water quality will deteriorate shortly. Water damage is due to the environment [4], users [4], and the fact that after a certain time, the disinfectant in drinking water no longer takes effect. Under current law, in our country is mandatory microbiological disinfection of drinking water with chlorine compounds. Drinking water pumped into the public distribution network must reach the consumer in a time of less than seven days. Because pools are open, i.e. water in contact with the environment, we believe that the effect of chlorine is effective for a shorter duration.

Environment contributes to the deterioration of water quality in swimming pools open especially [4], pollutant loads being flown. Some of these are listed under [4] in Table 2.

Table 2. Pool water quality deterioration due to the environment

Environmental Pollution	Mineral and organic materials	Germes
	vegetable scraps animal remains Dust and fines, others	

Significant deterioration of pool water is due to users. The contribution of chemical and microbiological generated by users leads to changing water quality in the pool, according to [4], presented in Table 3.

Table 3. Pool water quality deterioration due to users

Pollution users	Chemical influences and their form	soluble	- sweating - urine
		colloidal	- secretions - cosmetics
		suspensions	- leather - hair - others
	influences microbiological	- bacteria - viruses - mushrooms - other parasites	

Besides these we can add more accidental pollution, (confirmed in practice), which can occur even due to equipment serving pools (Table 4).

2.3. INFLUENCE OF POLLUTANTS FROM POOLS ON USERS HEALTH

Depending on the presence of chemical or microbiological polluted in water from pools, the influence on human health is varied. So may appear simple irritation of the skin, eyes or respiratory tract but also severe illness requiring prolonged treatment. From individual to individual, the same stimulus can create different reactions

Table 4. Accidental Pollution

Pollution	Effect
Accidental overdose of disinfectant	- Annoyance due to odor - Respiratory and eye irritation - Corrosive effect on some elements of the structure or installations - In the extreme case, poisoning
Overheating pool water (except the basins for treatment with thermal water)	- Discomfort, steam - Favors emanations due chlorine smell - Favors microbiological activity - other
Accidental discharge lubricant due to pumping aggregates failure or other	- The emergence of a film of grease to the waterline

Contracted diseases caused by biological agents such as viruses, bacteria, fungi or other parasites, or chemical agents such as right products for water treatment. Uploads mineral in water, due to environmental (solid particles such as dust or sand) creates discomfort, but unlikely to cause disease.

According to [8], the most common diseases contracted by attending swimming pools are Wart disease, transmitted by viruses, fungi of skin or nail and pool conjunctivitis. Most pathogens were not detected in the pool but the shower cubicles and lockers. Softened skin is a breeding ground for fixing them. Even the water properly treated with chlorine or ozone, there are several pathogens that are not affected by these disinfection measures. Chlamydia is an example of Serotype D-K, which causes conjunctivitis pool aforementioned.

The most dramatic case of illness due to pathogens transmitted through water in swimming pools is shown in [7]. Namely meningitis caused by Amoebas, "Naegleria fowleri" patient's illness followed by death. The event occurred in California in 2016, and despite the fact that the patient was presented to her physician I could not be saved. Subsequently thorough analyzes were performed by CDC Epidemic Protection Authority. It has been found that Amoebas entry to the body through the nose causing the infection. The pool in question is located in an arid area, water being brought by an inflow of 2.4 km in length, a spring with a temperature of 10°C. Water Disinfection was performed with chlorine, but only in the pool where the water temperature was 37°C (temperature conducive to the development Amoebas). It is assumed that the pathogen entered the water due to poor transportation pipeline and could not be annihilated quickly enough chlorine in the pool.

But disinfectants used, usually chlorine compounds, can cause illness or discomfort swimmers. Thus chlorine emanations affect asthmatics. Swimming is a sport even recommended them because it increases lung capacity and improves breathing technique. Since 2001, however, is doing research on the effect of chlorine on children and the risks posed to them [10].

Studies conducted in Belgium, [11], a number of 430 kindergarten children showed that 36% of children who attended pools with water disinfected with chlorine, showed lung infections such as acute bronchitis. The disease manifested before the age of three years.

2.4. DESINFECTATION METHODS FOR SWIMMING POOL WATER

In the process of treating water from swimming pools, disinfection is an important operation which applies in order to prevent the transmission of contagious diseases among different users and avoid the development of microscopic algae. Disinfecting procedures recommended are that with: chlorine gas; chlorine dioxide; sodium hypochlorite; calcium hypochlorite; bleach; bromine; ozone; UV rays and new TwinOxide [2]. Disinfectant used must meet the following requirements: to destroy in a short time existing pathogens in water; have a high stability; it can be easily controlled; do not cause harmful side effects; do not alter the organoleptic qualities of the pool water and not vitiate the air quality in premises covered of these arrangements [2].

Chlorine gas is the reagent with the most widely used for water disinfection of swimming pools. The use of chlorine involves, in addition to the many advantages also some shortcomings, with safety and health risks. Excess chlorine in disinfected water may cause the formation of trihalomethanes (THM) and mutagen X (MX), substances known to be carcinogenic and high risk to public health. In addition, excess chlorine from the water can vitiate also the atmosphere inside swimming pools arranged indoors [2].

Chlorine dioxide is known as an excellent disinfectant for drinking water treatment, pools and swimming basins. He does not lead to the formation of trihalomethanes and haloacetic acids [2].

Bromine and chlorine is the halogen family and is an oxidising agent with bactericidal activity and disinfection substance particularly strong, sufficiently effective to avoid the development of microscopic and filamentous algae [2].

Sodium hypochlorite is the chemical reagent with disinfecting particularly effective, being used to disinfect drinking water and swimming pools water [2].

Sodium hypochlorite is the result of the electrolysis of a solution of salt and water, which takes place in an electrolytic cell. The solution generated has a pH of 8-8.5 and a maximum concentration of chlorine equivalent of 6-8 g / l. The advantages of using the method of disinfection with sodium hypochlorite are: safe handling and easy to store; low operating costs and production; simple installation; does not lead to dangerous side-products [2].

An ultraviolet ray with wavelengths of 100-300 nm presents an effective bactericidal action. Using ultraviolet light to destroy bacteria and viruses has been promoted to swimming pool water disinfection since it does not interfere in any way with chemical

agents in water. Ultraviolet rays are produced by mercury-vapor lamps, placed in quartz balloons [2].

Ozone is an effective disinfectant with powerful and rapid oxidizing effect on the organic matter and algae, destroy bacteria and viruses from contaminated water, while improving color, taste and smell of water [2].

TwinOxide is a solution of chlorine dioxide, substance produced by IWW Institute of the University of Duisburg (Germany) - International approved and recommended for swimming pool water disinfection. TwinOxide totally destroy microorganisms present in water, viruses and pathogens, do not cause allergic reactions and generates no odor typical of swimming, does not favor the formation of trihalomethanes (THM) and other byproducts, is not corrosive and overdosing does not result in a immediate risk to swimmers [2]. TwinOxide is recommended to use after a preliminary disinfection with ozone or ultraviolet.

Natural biological membranes from the membrane of slow or artificial filters, are not only able to retain very fine mineral suspensions, but also pathogenic microorganisms, viruses and microbes. Are technologies of high effective but very expensive, which is why they have not found a wide application in technologies for treating water in swimming pools.

A case study about these methods of disinfection is amply shown in [2].

3. SURFACE WATER

If in the case of swimming pools (performance sports or recreation), water quality can be maintained by respecting rules of hygiene and the continue treatment (as presented in 2.4), but in case of surface waters, rivers and lakes, the quality is difficult to control, according to [6] these waters are divided into four quality classes. Even sampling for the analyzes presented in [5], [6], can sometimes be problematic.

However, these waters constitute an interesting alternative to swimming, especially since in addition to swimming or rowing can be practiced alongside other outdoor sports. Also, such an arrangement, beach, trees, green space and water in the vicinity of camping décor much nicer than a swimming pool closed. Facilities of this kind have been created on the shores of natural lakes, the rivers and on the banks of artificial lakes (storage dams, gravel pits and others). Figure 1 and Figure2 rowing and recreation on the river Bega from Timisoara.



Figure 1. Rowing on the River Bega



Figure 2. Recreation boats on the River Bega

If for boating, pedal boat or performance rowing, dangers of water depth and currents are lower, for bathing and swimming should be a clear demarcation of the area where these activities are possible and permissible. Should be taken in account the fact that bathing and swimming are related to seasonal and other weather conditions.

Bathe or practitioners' surface water sport is not without risks. Bacteria in the water can cause Diarrheal diseases [8]. Leeches and their larvae can cause irritation and infections of skin, Bath-dermatitis [8], [9]. In deep and cold water (mountain lakes), the danger is reduced. In the warm waters and muddy shores, these creatures may be present.

An outstanding technical work, which we believe should be recalled, is ensuring quality of bathing water on the River Isar, Germany (Isar, QM 1926-2006 175 m³ / s). Since the 90s was the question of ensuring quality water, allowing bathing on top of the river Isar. For this the Land of Bavaria took the necessary steps incentives for all operators canal spillway into the river or its tributaries, [3]. The idea was imposed, and since 2004 bathing in the river Isar is possible between 15 April to 30 September. The technical solution consists of disinfecting the treated water by treatment plants, by UV (ultraviolet), before its discharge into the river, for WWTP München and for other smaller towns, [3]. Some details of the treatment plant of München, (as the largest treatment plant in the area):

- Inhabitant values 1 million
- Dry weather inflow - 4m³ / s;
- Rainy weather inflow - 6 m³ / s;
- Disinfection facility on six lines with 300 UV lamps exposure;
- Operating expenses for the facility - 2-3 Euro cent / m³.

There was no need for lifting the price for channel water.

Laboratory tests and treatment plant outflow showed a destruction of bacteria by over 99%.

Yet it is possible that rainy, rain water dripping from the soil into the river to coach organic material pathogen.

4. CONCLUSIONS

Through this paper the authors do not want to discourage water sports. But it attracts attention to the dangers that athletes expose themselves.

There must be a separation between sports and recreation, primarily because the physical effort is another. Even if the pool is the same, occupancy is different.

Excess chlorine, favored by hot water, affects the performance of athletes and creates discomfort to all users, especially children.

If the pools closed, it recommends a very good ventilation of the space, through this eliminates chlorine odor and moisture, which penetrate throughout.

It cannot avoid all risk factors, even when the pools are covered and water disinfection plants working properly, already highlighted pathogenic bacteria resistant to chlorine and ozone [8]. Compliance with simple hygiene measures such as wearing glasses for swimming (using almost all athletes), or wearing slippers out of the pool can avoid many unpleasantness. Hygiene in swimming pools is an aspect which must take into account all users, both athletes and those who use the pool for recreation and relaxation.

Bathing and sports in surface water eliminates many disadvantages related to indoor pools, especially discomfort and diseases caused by chlorine, are however other risk factors.

Choosing where to establish a sports or recreational base at the water surface will take into account all the factors involved, the geographic, neighborhoods, other utilities and others.

Physical Disinfection, by exposing the water to UV radiation, it is an interesting alternative that can be widely applied, either independently or in combination with disinfection of water with chlorine.

Even if for performance sport or recreation uses boats, the danger of contamination is not excluded.

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