HEALTH AND WATER QUALITY OF SWIMMING POOL: THE ITALIAN REGULATORY GUIDELINES

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ABSTRACT

In 2003, the Italian Ministry of Health, with the technical support of the Istituto Superiore di Sanità (the National Institute of Health in Italy, ISS), the National Olympic Committee and representatives of the Italian Regions, issued a new Italian regulatory guideline (Agreement State-Regions) on "*Hygienic aspects for the construction, maintaining and control of swimming pools*" (1).

It came into force after a legal approval, through Regional regulations, from each of the 20 Italian Regions and established the essential hygienic, technical and management requirements of swimming pools.

The Agreement is the first national legislative provision intended to protect the health of pool workers and users by providing an all-embracing control of the water and environments. The general principles and minimum safety standards of hygiene throughout the country are also defined in the Agreement.

As a further development of the Agreement, a set of rules between the regions and autonomous provinces of Trento and Bolzano has been then implemented and formalized within the "Inter-regional protocol of swimming pools" (2).

The task of issuing detailed rules of implementation of the Agreement is demanded to the regions. Almost all regions in subsequent years have transposed and implemented the Agreement within their Regional legislation, including the environmental and hygiene requirements (Annex 1), which are therefore harmonized and valid throughout the national territory.

Pool water must comply with the parametric values established for a set of physical-chemical and microbiological parameters. Substances to be used for disinfection, flocculation, pH-correction as well as algaecides are specified and their purity degree indicated.

Hygienic-environmental requirements, such as thermo-hygrometric, acoustic and lighting-technical conditions are also fixed.

The health local authority is responsible for analytical controls of the fixed parameters, supervision of the autocontrol documents – produced by the self checking activities – and surveillance on the suitability of the corrective actions adopted in case of exceeding values or critical circumstances.

Keywords	guideline, pool, hygiene, autocontrol

1. THE AGREEMENT STATE-REGIONS OF 2003 ON "*HYGIENIC ASPECTS FOR THE CONSTRUCTION, MAINTAINING AND CONTROL OF SWIMMING POOLS*": THE ITALIAN REGULATORY GUIDELINES

The Agreement State-Regions approved in the 2003 is the first organic national legislative provision intended to protect the health of bathers by providing an all-embracing control of water and facility. It includes all the hygienic aspects related to the swimming pool construction, operation and maintenance, management and vigilance. The general principles and minimum safety standards of hygiene throughout

the country are also defined.

The following sections are included within the Agreement and endorsed by the Protocol:

- Definition;
- Classification of pools;
- Scope and purpose;
- Staffing, equipment and materials;
- Internal controls;
- External audits;
- Penalties;
- Transitional arrangements;
- Annex 1 (health and environmental hygiene requirements).

The task of issuing detailed rules of implementation of the agreement is demanded to the Italian Regions. Almost all the Regions in subsequent years have transposed and implemented the agreement within their Regional legislation, including the health and environmental requirements (Annex 1), which are therefore harmonized and valid throughout the country.

The Agreement establishes rules for the control and the management of swimming pools supplied with freshwater. Swimming pools, supplied with seawater and thermal water, are not covered by this regulation because their requirements are fixed by Regional laws. The field of application involves semi-public (*e.g.*, hotel, school, health club, camping) and public (*e.g.*, municipal) swimming pools and aqua parks. Domestic and in housing complex swimming pools and "hydrotherapy pools" are not comprised.

1.1 ITALIAN LEGISLATION ON SWIMMING POOLS: THE HISTORICAL OVERVIEW

Vigilance of hygienic characteristics of swimming pools in Italy has a long tradition.

Already in 1951, a Minister of the Interior' Circular letter established important issues such as the practicability of the pools, installations, facilities, the capacity of public, routes, services, rescue and treatment of water in the pool. But a real important advance was represented by two Circular letters issued by the Ministry of Health in which a particular emphasis was placed on the hygienic aspects. In fact, water treatment, physico-chemical and bacteriological requirements of water in the pool, mandatory measurements and record of free chlorine in the pool were the most significant features of the provision.

In 1991 a first organic formulation of a standard on swimming pools was developed. It was the Act of Arrangement among the State, the Regions and the autonomous Provinces of Trento and Bolzano. The act dealt with the designing of the premises and the physical and chemical properties of water supply in the pool. Unfortunately, the entrance in force of this guideline was poor, because of the inadequate legal basis regulating the relationship State-Regions at that time. This entailed some regions returned to apply the old Circular letters; other Regions partially took into consideration the Act, while other Regions implemented their own regulation.

This situation led to a decree of the Ministry of Interior establishing that security standards for the construction and operation of sports facilities can also be used for the swimming pools. In parallel, the standard 10637 by the Italian National Standards Body (Ente Nazionale Italiano di Unificazione – UNI), regulating several components and technical building equipments, was conventionally accepted by the stakeholders and authorities.

A dramatic recent evolution in the legal framework of Health and water quality of swimming pool consisted of the establishment in 2003, of a new Italian regulatory guideline (Agreement State-Regions) on "*Hygienic aspects for the construction, maintaining and control of swimming pools*" (1). The guidelines were designed and drafted by the Italian Ministry of Health, with the technical support of the Istituto Superiore di Sanità (the National Institute of Health in Italy, ISS), the National Olympic Committee (CONI) and representatives of the Italian Regions.

The textbook came into force after a legal approval, through Regional regulations, from each of the 20 Italian Regions and established the essential hygienic, technical and managerial requirements of swimming pools.

As a further development of the Agreement, in December 2004, a set of rules between the Regions and the autonomous provinces of Trento and Bolzano has been then implemented and formalized within the "Inter-regional protocol of swimming pools" (2).

1.2 HEALTH AND ENVIRONMENTAL REQUIREMENTS IN THE ITALIAN SWIMMING POOL

Recirculating filtered water and pool water must comply with the parametric values established for a set of physico-chemical and microbiological parameters (Table 1). The quality of water in the pool must be reached at any point. The control of water quality is carried out if the need arises for internal control or management problems have appeared by using the official methods of analysis for water intended for human consumption.

Substances to be used for disinfection, flocculation, pH-correction and algaecides are specified and their purity degree indicated (Table 2).

Besides the hygienic-environmental requirements, thermo-hygrometric, acoustic and lighting-technical conditions are fixed.

1.2.1 PHYSICO-CHEMICAL AND MICROBIOLOGICAL PARAMETERS

Table 1 Requirements that bath water must have according to the State-Regions Agreement of 2003.

PARAMETERS	POOL INLET WATER*	WATER IN POOL
Physical parameters		
Temperature: - Swimming pool - Swimming pool (for children) - Outdoor pool	24°C - 32°C 26°C- 35°C 18°C – 30°C	24°C - 30°C 26°C - 32°C 18°C - 30°C
pH (in case of chlorine disinfection) If other disinfectants are used, pH must be properly set to the optimum for disinfection.	6.5 – 7.5	6.5 – 7.5
Turbidity (as Si 02)	≤ 2 mg/ L SiO_2 (or equivalent to Formazin turbidity unit)	≤ 4 mg/ L SiO_2 (or equivalent to Formazin turbidity unit)
Coarse solid material	Not admitted	Not admitted
Suspended solids	≤ 2 mg/L (*0,45-µm membrane filter*)	≤ 4 mg/L (*0,45-µm membrane filter*)
Colour	Same as drinking water (Pt/Co)	Difference not exceeding 5 mg/L (Pt/Co) from values for inlet water
Chemical parameters		
Free chlorine (chlorination)	0,6÷1,8 mg/L Cl_2	0,7÷1,5 mg/L Cl_2
Combined chlorine (chlorination)	≤ 0,2 mg/L Cl_2	≤ 0,4 mg/L Cl_2
Combined use of ozone and chlorine: Free chlorine Combined chlorine Ozone	0,4 ÷ 1,6 mg Cl_2 ≤ 0,05 mg/L Cl_2 ≤ 0,01 mg/L O_3	0,4 ÷ 1,0 mg/L Cl_2 ≤ 0,2 mg/L Cl_2 ≤ 0,01mg/L O_3
Isocianuric acid	≤ 75 mg/L	≤ 75 mg/L
Organic compounds (*permanganate analysis*)	≤ 2 mg/L 02 more than drinking water	Difference not exceeding 2 mg/L O_2 from values for inlet water
Nitrates	= drinking water	Difference not exceeding 20 mg/L N03 from values for inlet water

Flocculants	≤ 0,2 mg/L as Al or Fe (relative to a flocculant used)	≤ 0,2 mg/L as Al or Fe (relative to a flocculant used)
Microbiological parameters		
Bacterial count at 22°	≤100 ufc/1 mL	≤200 ufc/1 mL
Bacterial count at 36°	≤ 10 ufc/1 mL	≤100 ufc/1 mL
Escherichia coli	0 ufc/100 mL	0 ufc/100 mL
Enterococcus bacteria	0 ufc/100 mL	0 ufc/100 mL
Staphylococcus aureus	0 ufc/100 mL	≤1 ufc/100 mL
*Pseudomonas aeruginos*a	0 ufc/100 mL	≤1ufc/100 mL
* recirculating filtered water		

1.2.2 MICROBIOLOGICAL REQUIREMENTS

Microbiological quality is the most important parameter for the safety of swimming pool water. As with drinking water, microbiological analysis of this water is aimed largely at detecting markers of faecal pollution. Thus according to the Agreement (1), *Escherichia coli* and enterococci must be no detectable both in pool inlet water and water in pool. Colony counts play a rather greater role as a marker of general water quality, thus the presence of low concentrations of bacterial populations is admitted. Periodical analytical controls for *Pseudomonas aeruginosa* and *Staphylococcus aureus* are also requested. In fact, both the bacteria are more resistant to disinfection respect to the bacterial indicators. For this reason their testing can be used for obtaining information on the operation of the technological system (*e.g.* failure of disinfection). Furthermore, *P. aeruginosa* is associated with disease, usually *otitis externa or folliculitis*, in people who have attended swimming pools and spa pools, and S. aureus can represent a risk associate with skin lesions. This bacterium has also been advocated as an indicator of quality of bathing water, including swimming pool. In the pool the limit values are higher than in the incoming water because it is inevitable their coexistence with bathers in the pool. The values correspond at the count that should be obtained under satisfactory conditions of operation. In the light of good hygienic practices, moulds are also requested to be checked on surfaces of the facility (pool edge, dressing room). Nome limit value has been fixed for this parameter.

1.2.3 SUBSTANCES TO BE USED FOR WATER TREATMENT

For the treatment of the recirculating filtered water the substances reported in the following Table 2 must be used as disinfectants, flocculants and pH correctors.

The use of substances not included in these lists must be previously authorized by the Ministry of Health.

Disinfectants	Flocculants	pH correctors	Algaecides
Ozone	Aluminum sulfate (solid or solution)	Hydrochloric acid	N-alkyl-dimethyl-benzil ammonium chloride
Liquid chlorine	Ferric chloride	Sulfuric acid	Poly hydroxy ethylene (dimethyl iminio) ethylene (dimethyl iminio) methylene dichloride
Sodium hypochlorite	Ferric chlorosulfate	Sodium hydroxide	Poly oxyethylene (dimethyl iminio) ethylene (dimethyl iminio) ethylene dichloride

Calcium hypochlorite	Aluminum poly hydroxy chloride	Sodium bisulfate	
Anhydrous sodium dichloroisocyanurate	Aluminum poly hydroxy chloro sulfate	Sodium bicarbonate	
Dihydrate sodium Dichloroisocyanurate Trichloroisocyanuric Acid	Sodium aluminate (solid and solution)		

1.2.4 HYGROTHERMAL AND VENTILATION REQUIREMENTS

In the swimming and bathing area of indoor pools, the air temperature must not be lower than the temperature of the water in the tank.

The limit value for relative humidity is 70%. The rate of air at areas used by visitors will not have to be higher than 0.10 m/s. Moreover, a change of air of at least 20 m^3/h per square meter of the tank must be ensured. In the other areas for visitors (changing rooms, sanitation, first aid), the replacement air must not be less than 4 volumes/h and the air temperature must not be less than 20 °C.

1.2.5 LIGHTING REQUIREMENTS

Artificial lighting must ensure conditions of visibility that will ensure both the safety of visitors and control by staff. However, the level of luminance on the floor and on the water must not be less than 150 lux. In the other areas for visitors (changing rooms, toilets, etc.) artificial lighting must ensure an average of at least 100 lux and 80 lux in the locker room and in toilets, respectively. In all naturally lit area an average amount of daylight not less than 2% must be assured. Finally, the installation of emergency lighting must be provided in case of lack of electricity.

1.2.6 ACOUSTIC REQUIREMENTS

In the swimming and bathing area of indoor pools, the reverberation time will not have to be greater than 1.6 sec while passive acoustic requirements and noise must refer to the current legislation.

1.3 CONTROLS

1.3.1 INTERNAL CONTROLS

An innovative element of the Agreement (1) involves the designing and implementation of an internal control (autocontrol) plan, implemented by the organization's structure under the direct responsibility of the administrator of the facility.

The auto-control plan should be specifically tailored to the single pool configuration and related facilities. It consists of a series of operating procedures, modulated on the basis of the specific characteristics of the plant and the process and scheduled with a specific frequency, aimed to monitor and maintain safety and hygiene in the swimming pool to minimize possible negative health impacts. As part of the system, a recording documentation is required to the administrator of each single facility

containing objective evidence which shows how well activities are being performed and results are being achieved; it includes procedures of good practice, hygienic quality controls, critical points and identification/assessment of potential risks (Box 1).

BOX 1. AUTO-CONTROL PLAN

- Specifics of the pool, including dimensions and depths, features and equipment and a plan of the whole facility with the details of technological systems (*e.g.*, plants and processes of water and air treatment, etc.).
- Identification of potential risk; a description of the main hazards based on Risk assessment/Risk management criteria are required together with safe operating procedures and corrective actions to be adopted.

- Communication to the public; arrangements for communicating safety messages to customers, ensuring maximum bather numbers are not exceeded, customer care and poolside rules.
- Lifeguard's duties and responsibilities, including special supervision requirements for equipment, etc., lifeguard training and numbers of lifeguards for particular activities.
- Water quality monitoring, including how often, how and where samples have to be taken, details of the operational and critical limits and actions to be taken if water quality is not satisfactory.
- Recording of the results of the analytical controls of the parameters.
- Detailed work instructions, including pool cleaning procedures, safe setting up and checking of equipments.
- First-aid supplies and training, including required equipment, its location, arrangements for checking it, first aiders, first-aid training and disposal of sharp objects.

1.3.2 EXTERNAL AUDITS

The external audits and the related water sampling will be made by the Local Health Authority according to criteria established by each Region, based on proper control plans, with particular attention to the critical points of management and prepared by the plant operator.

If the Local Health Authority determines that the pool have failed the set health standards, it has to put in place the necessary checks taking the necessary steps to restore these requirements, until reaching a possible plant closure.

The Local Health Authority is responsible for analytical controls of the fixed parameters, supervision of the auto-control documents and surveillance on the suitability of the corrective actions adopted in case of exceeding values or critical circumstances.

2. CONCLUSIONS

Despite the activity of vigilance of hygienic characteristics of swimming pools has had a long tradition in Italy, the State-Regions Agreement of 2003 (1) represents the first organic regulation ensuring an effective overall system for the safe and healthy use of swimming pools. The approach take in main account the first draft of the *Guidelines for Safe Recreational Water Environments* provided by WHO (3).

The State-Regions Agreement of 2003 (1) opened a new phase in Regional legislative matter for health protection in swimming pools, resolving many previous drawbacks, such as the lack of harmonized approach to pool safety, the poor availability of scientific references and the weakness of the legal basis.

Indeed, the implementation of the Agreement (1) by most of the Italian Regions is providing several points of certainty and assurance for the protection of health in pool environment. Particularly, the environmental hygiene requirements in the Italian swimming pool, thus including chemical-physical and microbiological parameters, but also the criteria for temperature, humidity, together with acoustic and lighting requirements, and still not neglect the possible use of substances in water treatment.

Currently, a working group instituted at the Ministry of Health is working on the revision of the Italian Agreement, to take into account the progress in scientific and technical knowledge. The inclusions of new microbiological and chemical parameters and the removal of other ones less relevant for bathers' safety are considered within the revision. Alternative or new treatment technologies are also considered to combine with those already authorized for microbiological control and for the minimization of disinfection by-products.

An intense training activity is performed on annual basis by the ISS, involving sharing of criteria, methods and procedures for surveillance of hygienic characteristics of swimming pools by the Regions.

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