



Water treatment for aquatic facilities

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This is an initiative between the Department of Sport and Recreation (DSR) and the Leisure Institute of WA (Aquatics) (LIWA Aquatics) to improve the planning, design and management of aquatic facilities.

The definition of disinfection is removing the risk of infection, but in the context of swimming pools the term acknowledges that the water cannot be sterile. A few living, but normally harmless, micro-organisms will always be present. Disinfection aims to keep their number to a minimum and ensure that any harmful organisms entering the pool water are rapidly deactivated so that the water will not transmit infection to bathers. Proper disinfection is achieved primarily by maintaining the correct concentration of disinfectant in the water.

At the same time, other water quality parameters, in particular pH value, must be kept at the correct values for disinfectant to act effectively and efficiently.

Many disinfectants are also capable of oxidizing waste matter, controlling the build-up of what is the food for many micro-organisms (as well as water contaminant in its own right). Mains water contains a certain amount of such material, but the chief source is sweat, skin particles, mucus and urine. Such bather pollution can be minimised by pre-swim hygiene.

PART B – DISINFECTION

This is the second part of a two part series on water treatment for aquatic facilities. Disinfection must extend beyond the pool water to the filters (refer to the Part A Focus paper on ‘Water treatment for aquatic facilities – filtration and hydraulics’). In the filter, plant micro-organisms often find excellent conditions for rapid reproduction – warmth, darkness, a bed (of sand usually) to lie on and a plentiful supply of food coming by.

Determine your needs

Choosing the best disinfection system can be confusing and difficult. Any decision you make should take account of your specific needs.

Prior to considering your options you should be able to answer the following questions:

Issues	Preliminary questions and considerations
Location	Will the pool be indoor or outdoor?
Heating considerations	If indoor, how will air temperature be controlled?
Pool temperatures	Will the pool water be heated and to what temperature?
Supply water	From where will the water originate?
Water quality	Can a recent analysis of supply water be obtained to establish water quality indicators?
Pool volume	What will be the total volume of water to be treated?
Bather loading	How many bathers are expected per day?
Operating hours	What periods of non-use will be available for recovery of water quality, maintenance treatments or special applications?

It is important to be aware of the chemical quality of supply water to best match the disinfection system to the supply. The main chemical parameters of supply water that will impact on the choice of disinfection include pH, total alkalinity, calcium hardness, sodium chloride, total dissolved solids, iron, copper, manganese, sulphates, nitrates and phosphates. A complete report of water supply water quality is strongly recommended.

Check standards

The design of public aquatic facilities is regulated by a number of standards. A full list of statutory requirements is provided in the following:

- Health (Aquatics facilities) Regulations 2007
- Health Act 1911
- Government of Western Australia. (2007). Code of practice: for the design, construction, operation, management & maintenance of aquatic facilities. Perth, Western Australia: Department of Health.



Gather industry information

Contact should be made with relevant industry organisations to obtain general guidance and to source up-to-date information on research findings, new technology, trends and operational/management experience. Several helpful industry groups are listed below:

Leisure Institute of WA Aquatics (LIWA)
PO Box 726
Hillarys WA 6923
Website: www.liwaaquatics.net.au

Royal Life Saving Society (WA)
PO Box 28
Floreat Forum WA 6014
Email: info@rlsswa.com.au
Website: www.lifesavingwa.com.au

Swimming WA
PO Box 205
Leederville WA 6903
Email: waswim@wa.swimming.org.au
Website: www.wa.swimming.org.au

Department of Sport and Recreation
PO Box 329
Leederville WA 6903
Email: info@dsr.wa.gov.au
Website: www.dsr.wa.gov.au

SPASA WA
PO Box 371
Belmont WA 6984
Email: info@spasawa.com.au
Website: www.spasawa.com.au

Sanitiser types

Disinfectants perform two major functions; sanitise and oxidise. The sanitiser must provide a persistent residual (required to kill bacteria quickly), which prevents cross-contamination of bathers and is readily tested on-site. The oxidiser is required to oxidise organic impurities (e.g. algae, body fats) and inorganic contaminants (e.g. combined chlorine, metals). Traditionally, chlorination has been used for disinfection. Chlorine gas has for decades been the principle disinfectant for public pools.



Additional or alternative systems

Ultra Violet Irradiation (UV)

In pools and spaces, UV works in two ways:

- initiates photochemical and photo-oxidation reactions that destroy chloramines, the compounds responsible for unpleasant smells in indoor pools
- kills bacteria, viruses, moulds and their spores, reducing the risk of infection to bathers

The benefits of UV are that it:

- provides excellent water quality and a more pleasant bathing and working environment
- reduces the amount of chlorine required (approximately 50 per cent)
- is non-hazardous and chemical free
- treats the full circulation flow
- provides improved air quality
- reduces building fabric deterioration

Ozone

When ozone gas is dissolved in water it acts as a very strong oxidiser. Reactions occur with impurities, such as bacteria, algae, combined chlorine and body fats. Water is left very pure but excess ozone, due to its toxicity, must be removed. Hence no residual exists. A free chlorine or total bromine residual is required to protect bathers from cross-contamination. A highly reactive oxygen compound manufactured on-site, ozone (O₃), is produced by splitting the oxygen (O₂) molecule. Ozone can be generated using corona discharge or UV-light methods.

In an ozone system, water entering the pool must be ozone free. This is normally achieved by using a carbon or anthracite filter. Ozone systems must have all of the essential components in working order to achieve expectations. If components are undersized or omitted in order to meet budget constraints, water quality will suffer and the system will fail.

Cautionary note: Although ozone is regarded as a very efficient sanitisation system, the operation and maintenance is very technical and expensive. The availability of technicians in WA, particularly in rural and remote areas, make this system less attractive.



Water Balance

Successful disinfection depends upon proper sanitising and correct water balance. Water balance measures the corrosive capacity of the water and is determined by the following factors, which must be monitored at varying frequency:

- pH – important for bather comfort, equipment protection and sanitiser activity
- total alkalinity (ppm) – required as a pH buffer to ensure stable pH
- calcium hardness (ppm) – represents the amount of calcium in the water and describes water softness (low calcium) or hardness (high calcium)
- temperature (°C) – where no heater is fitted, temperature is determined by the weather. The temperature of the operation determines the type of activities accommodated
- total dissolved solids (TDS) – measures all solids and salts dissolved in pool water. TDS is increased by the addition of bathers and chemicals. Regular backwashing helps to prevent build-up of TDS by dilution with fresh water

Dosing equipment

Filtration is only one step in the clarification process. The real key to crystal clear water is disinfection. Automatic systems deliver continuous disinfection with a degree of accuracy by controlling the delivery of chemicals to pre-set parameters. They are, however, not a substitute for a well-trained and qualified operator. A test kit must be provided to monitor chemical quality of the water. Results of manual testing, along with any automated results, must be recorded and used as a management tool.

Automatic dosing systems dispense liquids, gases and solids (tablets). A tank or reservoir of chemical must be provided. Automatic feeders dose at a set rate, regardless of the levels in the pool water. Controllers are installed to ensure dosing occurs only when chemicals are required.

Feeders

The form of sanitiser will determine the feeder type. A tank will require provision of a chemical reservoir. The size of the tank and rate of feed must be designed to meet anticipated dose rates. Pumps, solenoids, tanks and feed tubes must be chemical resistant. Feeding of chemicals should occur downstream from the sensor.

Controllers

The sensor or probe acts as a monitor that detects the chemical level and feeds as required. When the parameters are outside the desired level, the system will relay a signal to the solenoid or pump/motor. This allows the chemical to enter the system. The method of entry is dependent upon the feeder and chemical type. Once the set level is achieved, the probe detects this and switches off the motor or valve, which prevents further chemicals entering the water. Interlinking of the controller with the circulation pump is required.

Water passing the probe deposits metals and body fats on its surface, which interfere with readings. The probe must be periodically cleaned, even in systems which claim automatic probe washing.

The meter reads out the level being monitored by the probe. This reading should be recorded when testing to compare with manual results. Some more expensive systems will allow installation of computer software control. This provides regular printed records of levels monitored.

Operations and maintenance

Adjustments should be made during the day by altering the rates at which chlorine and acid are added. Addition of other chemicals should occur following the last evening test, after the bathers have left the pool.

To reduce contaminants, consider the following:

- keep pool surrounds and facilities clean and disinfected
- do not rinse run-off water into pool
- ensure adequate ventilation is present in the pool hall
- avoid condensation
- regularly clean and maintain filters
- where possible, require bathers to pre-wash before entering the pool
- where possible, only allow recognised swimwear to be worn in the pool (practically important for indoor facilities) – ‘no street clothing’

Records

To monitor conditions and in cases of complaint, it is essential to keep records of the following tests:

- free chlorine/total bromine
- total chlorine
- combined chlorine
- pH
- redox (where fitted)
- electronic pH (where fitted)
- total alkalinity
- cyanuric acid (outdoor pools only)
- calcium hardness
- date
- time
- actions
- initials

Consultants' brief

A suitable design brief must be developed before appointing any consultants. The brief will describe the project, equipment and expected performance requirements.

In order to write the brief, it will be necessary to research disinfection options and identify their advantages and disadvantages. Information can be obtained from existing facility managers, industry organisations, chemical and equipment suppliers and the internet.

Consultants should have suitable qualifications, belong to an appropriate professional organisation and ideally be independent of any supplier. A previous history of similar projects should be exhibited by the consultant/s, with a list of previous client contacts. Details of their role and responsibilities should be identified within the brief.

The table below outlines a range of consultants that may be required when designing and installing a disinfection system.

Some questions that might be researched in preparation of the brief are listed below.

- Are there any construction materials with which the chosen system is not compatible?
- What manual procedures will be required?
- What components of the system can be automated?
- What is the expected chemical usage?
- What are the expected external service costs?
- What size system would be required?
- How much will the basic system (required for the job) cost?
- What additions/improvements can be incorporated and at what cost versus benefits?
- How much will the chemicals cost for general operation?
- What are the expected replacement costs of the equipment?
- What is the life expectancy of the equipment/ guarantee?
- What are the regular on-site maintenance requirements?

It is important to maintain control during the design and construction process. Be aware of sub-contracts that may be granted. Establish a path of accountability to prevent confusion and improve communications.



Consultant	Role
Engineer	system design and previous history
Hydraulic specialists	design of water treatment system, preliminary plumbing
System/equipment suppliers	sizing, provision, installation, servicing of ancilliary equipment
Water quality professionals	referred to for water analysis, operator training, maintenance strategies
Local government	responsible for employment and management of the majority of aquatic facilities
Leisure Institute of WA (aquatic)	provide independent advice or 'peer review' of design



Case studies

Once a proposal is put forward regarding the choice of system, it is extremely important to visit sites that have operational experience of that equipment. The following case studies provide a starting point – the more sites visited, the better the choices that will be made.

Balga Leisurepark

The Balga Pool was an aging facility that did not meet the needs of the local community. It was built in 1979 and was a seasonal, unheated outdoor facility consisting of a 51m pool, learn to swim pool and toddlers splash pool. The original plan and circulation equipment did not meet Health Department regulations pertaining to circulation and turnover rates.

The site was redeveloped and in April 2008 the new state of the art aquatic centre opened with three gas-heated indoor pools including an eight lane, 25m pool heated to 27°, children's leisure pool with beach access heated to 28°, hydrotherapy pool heated to 33° pool and an outdoor water playground.

The City incorporated into the centre design elements that assisted in achieving energy efficiencies that resulted in reduced operational costs. The design for the indoor pool structure has allowed maximum use of solar lighting. The overall design of the building incorporates significant use of moveable walls. This provides for a maximum use of natural light and keeps air-handling costs to a minimum.

The heating system is heat pumps and gas boilers. Gas, being a natural resource, was the preferred system for energy efficiency. This system also allows for a longer life expectancy of the pumps and associated equipment.

Park Aqualife Centre – Town of Victoria Park

Situated on the former Somerset Street pool site in East Victoria Park, the refurbished facility was re-opened to the public on 9 April 2006. One of the original 50 metre, eight-lane pools has been rejuvenated with a face lift and new filtration system.

The indoor aquatic area consists of a 25 metre, six-lane pool, leisure pool, hydrotherapy pool, spa and steam room. Sodium hypochlorite, hydrochloric acid and CO₂ are the main chemical controllers through

automatic dosing systems. DE filters are installed on all five separate water bodies and UV filters are installed on all indoor pools.

The Town is now in the process of installing a solar hot water system to heat the pools' water. Solar heating is cost competitive with both gas and heat pump pool heaters and has very low annual operating costs.

The system comprises a number of absorbers placed on the roof (north facing side) of the building. Pool water is then pumped through the filter and then through the solar absorbers where it is heated before it is returned to the pool.

The main advantage of this system is that it is environmentally friendly and has low running costs.

Contact: Phone (08) 9361 3312 Fax (08) 9362 2643

Email: aqualife@vicpark.wa.gov.au

Website: www.vicpark.wa.gov.au

Aquarena – City Of Geraldton Greenough

The City of Geraldton Greenough's original swimming pool was built in 1972. It was a 50 metre, eight-lane pool with a 'T' shape 30 metres wide at the deep end to accommodate water polo. Diving boards were removed some time later. In 1992, two full size beach volleyball courts were added.

In 1999, an indoor complex was added comprising of a multi-purpose pool 25m x 33m providing 13m x 2.5m x 25m lap lanes or international standard water polo pool, 600m² leisure pool including 47m flume slide, lazy river, spa, hydrotherapy pool, spa pool café and associated services.

Aquarena was one of the first aquatic centres to include Ultra Violet Light (UV) technology to assist in the management of all water bodies. The technology was incorporated within the original design and some very innovative alterations/additions to the mechanical services and hydraulic systems, including water-wise and air management practices.

Contact: Phone (08) 9921 8844 Fax (08) 9921 8855

Email: hassellc@geraldton.wa.gov.au

Website: www.geraldton.wa.gov.au



Bayswater Waves

Originally built 31 years ago and renovated in 1998, this modern centre now comprises two outdoor and five indoor pools including a 50 metre Olympic pool, diving pool, 25 metre lap/short course pool, wave pool, spa, hydrotherapy pool and toddlers pool.

The original gravity sand filtration and gas chlorination has been retained in the outdoor 50 metre and diving pools. All indoor pools use medium rate sand filtration and until recently was combined with ozone installations. The ozone has been replaced with UV technology, with disinfection provided by chlorine gas and soda ash as required.

Contact: Phone (08) 92766 538 Fax (08) 9276 9190

Email: waves@waves.bayswater.wa.gov.au

Website: www.bayswater.wa.gov.au

Fremantle Leisure Centre

In 1971, the centre opened with 50 metre and 25 metre outdoor seasonal pools. The circulation system comprised of gravity sand filters and chlorine gas as the primary disinfectant.

Redevelopment began in 1993 with installation of an indoor gas-heated, salt-chlorinated hydrotherapy pool and conversion of the outdoor pools to a heated, salt-chlorinated system. Additional stages of the development process has seen the inclusion of a gym/fitness facility, crèche, café and also included high-rate sand filters, tiling and other additional facilities. The facility is currently converting from sodium hypochlorite back the original gas chlorine installation.

Contact: Phone (08) 9335 6233 Fax (08) 9430 8760

Email: johne@fremantle.wa.gov.au

Website: www.freofocus.com.au

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