Swimming Pool & Spa International Conference 2009

Paper 5.4

Water Treatment Design for the London Aquatic Centre 2012

Tom Devin, Consultant, Devin Consulting Limited, UK

Synopsis

The new London Aquatic Centre for the 2012 Olympics in London will contain four new pools. Each pool will have its own independent water treatment system. Treatment will include flocculation, sand filtration, ultraviolet irradiation and chemical treatment. Turnovers in the pools will range from 13 minutes up to 5.8 hours.

All of the water treatment equipment will be housed in a common plant room typically located between the two 50m pools. Major provision has been allowed for the access and maintenance of the water treatment systems. In addition walkway ducts are being provided around all sides of the pool for a range of services, and these will also incorporate all of the water treatment pipework. The air handling strategy will incorporate wet ducts whereby the moist air layer above the surface of the pool will be removed via the specially designed transfer channels. A range of sustainability issues have also been incorporated, including the recovery of backwash water for re-use in the toilets in the complex.

The London Aquatic Centre for the 2012 Olympics

A new aquatic centre has been designed for the 2012 Olympics in London. The building is currently on site and is due for completion in June 2011, a full year ahead of the games. The centre has been designed to operate in both games mode and legacy mode, and this has required specific attention to the manner in which the pool tanks, their flexibility and their water treatment systems have been designed.

In the twenty year period prior to 1989, no new 50m swimming pools were built in the UK or Ireland. However, between 1989 and 2009, eighteen new 50m pools have been constructed in the UK and Ireland, and a further eight 50m pools are either on site or on the drawing board. This number of 50m pool developments, has resulted in a substantial body of design knowledge in a number of design offices throughout the UK. Recent 50m pool projects of note include the Manchester Aquatic Centre (2001) for the Royal Commonwealth Games of 2002, Ponds Forge in Sheffield for the World Student Games 1991, Wales National Pool, Swansea (2003) and Loughborough University for the English Institute of Sport (2003). In tandem with these swimming pool developments, a number of British Standards and guidelines have been published that provide specific guidance on swimming pool water treatment. These include publications from the Pool Water Treatment Advisory Group[(1)], The Health and Safety Executive [(2)], The Publicly Available Specification from the British Standards Institute [(3)], and the new European Norm on Swimming Pool Equipment [(4)].

There are four pools in the Aquatic Centre

- the Main Competition Pool, 51.25m x 25m x 3.0m deep, ten lanes
- the Diving Pool, 25m x 21m x 5.0m deep
- the warm up pool, 51.25m x 21m x 2.0m deep
- Diving warm pool 3.0m dia.

Four independent water treatment plants will be provided, i.e. one for each pool. All of the water treatment equipment will be housed in a single plant room in the basement of the building, strategically located between the two 50m pools. From the plant room, full height walkway ducts run the full length of all pools, providing access to the sides of all pools. These ducts allow for the provision of viewing windows into the pools, water distribution pipework, air deliveries and other services. Access for maintenance and replacement of all items of water treatment plant is provided by means of a 3.5m wide x 3.5m high corridor that runs the length of the plant room and then connects the plant room to the outside of the building.

50m pool tanks are substantial structural elements and from the time of construction through to commissioning can undergo significant movement. Primarily for this reason, but also in order to minimise risks from buried pipework, the decision was taken early on in the design stage not to have any pool water distribution pipework buried under or adjacent to the pool tanks. The pool surround ducts facilitate the running of pipework adjacent to the pool tanks and within the pool tanks themselves floor ducts will be formed in the base of the pool in which pipework will subsequently be installed and then back filled. This approach has previously been used successfully on a number of 50m pool projects.

The water distribution system must ensure that treated water is distributed to all parts of the pool, polluted water is removed efficiently and effectively from the pool and full allowance is made for the varying pool configurations due to the incorporation of movable floors and traversable booms. A similar distribution principle has been applied to each of the three main pool tanks, and incorporates side wall inlets, both at high and low level, base inlets to ensure effective distribution over all parts of the pool under the movable floor, transfer channels with a capacity to remove up to 100% of the pool water circulation, and base outlets.

Water distribution and air quality are often inter-related. A good air quality strategy should consider minimisation of the amount of pollution introduced into the pool water, ventilation that addresses the specific operating characteristics of a pool and the pool water treatment itself. At the LAC, specific attention has been given to the air zone above the pool water area, where humidity and the concentration of disinfection by products will naturally be highest. Air will be supplied over the pool water, with the return pool air ducts along the long sides of the pool drawing air in via the specially designed transfer channels. By removing this moist contaminated air as close to the source as possible, it minimises the risk of its transfer to other parts of the building.

The transfer channels are designed to ensure effective surface water removal along all transfer channel edges. As well as allowing for air transfer from the pool, the transfer channel profiles are designed to minimise the splashing of water into the transfer channel. Splashing causes noise and also can cause an increase in the pH of the water due to the loss of carbon dioxide to the atmosphere

The transfer channels connect to the balance tanks which are sized for both normal operation and also allow for full backwashing of all sand filters.

The primary pool water treatment elements will include:

- a turnover or circulation rate of treated water appropriate to each specific pool
- water removal via deck level transfer channels to remove polluted surface water
- water collection in balance tanks
- straining to remove gross debris
- pumping, controlled by variable speed derives
- flocculation to enhance the performance of filters
- filtration to provide water clarity
- pool water heating for initial heat up and operating loads
- chlorination to prevent cross infection between bathers
- pH correction for the correct acid/alkali balance
- supply of treated water to all parts of the pool tanks, allowing for movable floors and movable booms
- distribution of treatment water to have minimum effect on competitive swimmers
- taking into account the maximum potential bather loads for the different movable floor and boom configurations in each pool

There are various additional treatments on the market that can or claim to be able to provide an enhanced quality of water, many of these were reviewed, including various applications of ozone and ultraviolet irradiation (UV). A UV system will be installed in order to minimise chloramine levels in the water and also to provide for an enhanced level of disinfection.

The water treatment proposals for the four water areas are as follows:

	Competition Pool	Warm-up Pool	Diving Pool	Diving Warm Pool
Water area m^2	1250	1050	525	7
Bather load	367	477	239	22
Turnover hours	4.2	2.6	5.8	13 min
Hourly flow m^3/hr	810	810	450	34
Additional treatment	Full flow UV	Full flow UV	Full flow UV	Full flow UV
Temperature ^oC	27-30	27-30	27-29	35-36
Free chlorine mg/l	0.5 – 1.0	0.5 – 1.0	0.5 – 1.0	1.0 – 1.5
pH	7.0 – 7.6	7.0 – 7.6	7.0 – 7.6	7.0 – 7.6
Langelier Index	0 – 0.5	0 – 0.5	0 – 0.5	0 – 0.5

Water sustainability is a key part of the overall sustainability agenda for the centre. Variable speed drives will be installed on all main circulating pumps to facilitate optimum operational conditions for the pumps. The system hydraulic design will minimise head loss through appropriately designed pipe sizes and components. The backwash water from the sand filters will be recovered for toilet flushing. Instrumentation will be provided for all aspects of plant monitoring.

Bibliography

1.Swimming Pool Water Treatment and Quality Standards, Pool Water Treatment Advisory Group (PWTAG) 1999.

2. HSG 179, Managing health and Safety in Swimming Pools, 2003.

3. PAS 39: 2003 Management of Public Swimming Pools – Water treatment systems, water treatment plant and heating and ventilation systems – Code of practice.
BS EN 13451-1:2001 Swimming pool equipment – Part 1: General safety requirements and test methods.
BS EN 13451-3:2001 Swimming pool equipment – Part 3: Additional specific safety requirements and test methods for equipment for water treatment purposes

4. Health and Safety at Work Act 1974.
Code of practice for ozone plant for swimming pool water treatment, British Effluent and water Association (BEWA) 1990.