Jacksons Engineering

Managing HVAC and pool filtration systems in unoccupied swimming pools

Introduction

The purpose of this paper is to provide guidance and strategies on the operation of indoor swimming pool and aquatic facilities, where the facility may be temporarily or partially shut down for relatively short periods – for example, a period of 4 – 12 weeks.

These facilities are recognised as relatively high energy users, and it is desirable to minimise energy consumption during times when the facilities are not in public use.

Indoor swimming pools and aquatic centres, particularly complex municipal facilities, are typically fitted with specialist pool water filtration and treatment systems to ensure safe and sanitary conditions for the users, as well as complex heating, ventilation, and air conditioning (HVAC) systems to maintain the required indoor environmental conditions.

The HVAC systems serve multiple purposes as outlined below:

1. Ensure the space is reasonably comfortable for occupants, whether they are fully clothed spectators or swimmers in costume on the concourse.
2. Manage and dilute elevated concentrations of chemicals from the air which are natural by-products from the pool water disinfection process.
3. Protect the building fabric from accelerated degradation and damage due to sustained high levels of moisture and potential condensation from pool water continuously evaporating into the air inside the pool hall.
4. Ensure adequate ventilation is provided for the building occupants to meet or exceed the compliance requirements under clause G4 of the New Zealand Building Code.

The pool water and filtration systems are primarily designed to filter and chemically treat the pool water to maintain an acceptable level of water quality. In almost all facilities, they also heat the water to ensure a more enjoyable and consistent user experience.

We have considered the HVAC and pool water treatment systems separately with a focus on energy reductions, whilst ensuring the minimum operational requirements can be met.

As the design and layout of each facility is unique, this article is aimed at providing general guidance and recommendations only. For guidance regarding a specific aquatic pool complex, we recommend seeking professional advice from a specialist engineer.

Humidity, condensation, and ventilation

Water from the swimming pools continuously evaporates into the air within the pool halls. The rate of evaporation increases as:

- The size of the pool increases.
- The pool water temperature increases.
- The pools' usage increases, due to the increased wave action, splash, and larger area of wet surfaces such as the floors surrounding the pools.

This continuous evaporation of the pool water results in an increase in the relative humidity of the pool hall air, which in turn increases the likelihood of condensation on internal surfaces.

Condensation occurs when this humid air contacts a cooler surface, causing excess moisture to 'condense' onto the cooler surface. The colder the surface, the higher the rate of condensation. The temperature at which condensation first forms is referred to as the dewpoint temperature.

When considering the building envelope, this effect can most readily be seen on the windows, as the glass is typically the coldest element of the building fabric. Double glazing results in a marked reduction in condensation as the inside pane of glass is warmer than the exterior glass.

Less noticeable is condensation that can occur on the inside surface of timber or painted surfaces of external walls or the roof, which tend to be cooler during the winter months. Again, additional insulation to the walls or roof will reduce but not necessarily eliminate the formation of condensation.

To reduce the potential damage resulting from unwanted condensation, a vapour barrier is typically installed at or close to the internal surface of all exterior walls and the roof. This helps prevent moisture from permeating the wall or roof linings and support structures, which can damage the building structure and fabric, with serious consequences.

Providing adequate ventilation and treatment of the air within the pool halls addresses the problem at source. Two methods can be employed independently or together for this purpose:

1. The use of outdoor air ventilation.
2. The use of proprietary dehumidification equipment.

The more common approach in New Zealand (due to our relatively temperate climate) is to supply large quantities of outdoor air into the building, appropriately heated to provide occupant comfort, so that this supply of less humid air continuously purges the moist air from the pool halls. This helps to maintain the humidity at a lower level where condensation should not occur on the cold internal surfaces of the building's exterior walls. More complex systems can vary the amount of air supplied to control the humidity level more accurately, providing an energy advantage over fixed volume systems.

The air in the pool halls also contains small amounts of chlorine because of the pool water disinfection process. This chlorine will be present in any condensation which occurs, and will result in accelerated rates of corrosion, especially on steel surfaces.

Note that the level of water evaporating from the pool surface is significantly reduced using pool covers when the pools are not in use.

Reducing energy while protecting the building

While protection of the building fabric is of prime importance, it is possible to minimise energy consumption of these facilities while they are unoccupied, without completely shutting them down.

Strategies include:

1. Minimising the rate of evaporation from the pools.
2. Minimising the operation of the ventilation systems.

3. Minimising the operation of the pool water Filtration and Treatment Systems.

Minimising evaporation from the pools

The following steps will help to minimise the rate of water evaporation from the pools:

- Cover the pool to reduce the exposed water surface area.
- Turn the pool water heating system off, as reducing the pool water temperature will reduce the rate of evaporation from the pool.

Minimising the operation of the HVAC systems

As the facility is unoccupied, space temperatures can be allowed to drop below optimum occupant comfort levels.

For simpler systems, without the ability to control individual plant items, the following steps will help to minimise the energy consumed by the HVAC systems:

- Leave the HVAC systems running continuously but reduce the space temperature setpoint. As the pool water temperature decreases, gradually reduce the space temperature set point for the pool HVAC system to a minimum of 18 - 20oC. (Note that the space temperature setpoint should always remain at or above the prevailing pool water temperature)
- Minimise the ventilation rate by increasing the relative humidity setpoint or setting the ventilation rate lower by manual means (dependent upon system configuration). The resultant reduced level of ventilation will reduce the amount of heating required to the outside air, while still controlling condensation within the facility. This can be safely done provided that the heating setpoint is set as above, or higher. The amount of increase will depend upon the local climate amongst other things and specialist advice should be sought prior to implementing this strategy.

In addition to the above measures, for more complex systems which can control individual plant items via a BMS or similar, we suggest switching the heating plant off on warmer days, and then back on again as the ambient temperature drops below about 16oC (i.e., at nights or in cooler weather), where there is risk of the building fabric temperature falling below the space dewpoint temperature.

Note that the HVAC systems cannot be switched off completely as the moisture levels within the pool halls will steadily increase, leading to a high risk of condensation and resulting damage to the building.

Note also that the heating systems need to remain operational to ensure the space surface and air temperatures remain above the pool water temperature and space dewpoint temperature, where condensation would otherwise occur.

Minimising the operation of the pool water filtration and treatment systems

As the facility is unoccupied, the loading on the pool water Filtration and Treatment (F&T) system is significantly reduced, providing the opportunity to either reduce the operation of the F&T system or fully decommission it. The latter requires re-establishing the water quality and temperature requirements for the pools prior to putting the facility back into service.

Intermittent operation of F&T system

If the pool is not in use, the F&T system can be operated on an intermittent basis for 2-3 hours per week, or as required. Whilst running, a shock dose of chlorine should be added to the pool and allowed to circulate. Note this strategy relies on undertaking a weekly visit to the pool to dose the system.

Chlorine levels should be tested and monitored and timing between shock doses adjusted accordingly.

Shutdown of F&T system

Alternatively, the F&T system can be shut down for the entire period that the facility is intended to be out of use.

We recommend the following is undertaken:

- Backwash sand filters for a long period.
- Wash down DE filters (Vacuum and Pressure).
- Leave all empty, including sand filters.

If dosing controllers are installed, power down the controllers and:

- Remove the pH probes from the sample station. Note it is important these probes are kept moist by immersing them in an appropriate solution.
- Chlorine probes should be removed from sample stations. Follow the manufacturer's instructions for probe storage and ensure that they are protected from mechanical damage.
- All other probes should also be removed. Note it is important to keep these probes moist by immersing them in an appropriate solution.
- Where possible, empty all pipework, pumps and strainers that are above the normal level of the pool, to prevent corrosion of metal components in the devices.

Note that the pool water without an operational F&T system will lose its colour and clarity, and may contain microbiological organisms, so poses a biological hazard that requires managing.

The pool can be restored quite quickly by following a proper start up procedure, which will include a shock dose of chlorine and operation of the F&T system for a few days prior to the pool being re-opened. This start-up period also allows time for pre-heating of the pool to the normal operating temperature.

Draining of pools

It is not recommended that the pools be drained, for two reasons:

1. Most coatings applied to the inside of a pool are designed to be continuously wet to ensure maximum life. Ideally, they should not be allowed to dry out for extended periods.
2. Hydrostatic pressure from rising ground water presents a real risk to the structural integrity of the pool tank and can cause empty pools to fracture or to be displaced.

Jacksons Engineering

Information provided by
Jacksons Engineering Advisers Ltd

For any enquiries or assistance, please contact us on the numbers below.

Auckland – Head Office
t. +64 9 378 8736
e. info@jacksons.co.nz

Waikato
t. +64 9 378 8736
e. info@jacksons.co.nz

Bay of Plenty
t: +64 9 378 8736
e. info@jacksons.co.nz

Hawkes Bay & Central Region
t. +64 6 870 1300
e. info@jacksons.co.nz

Otago & Southland
t. +64 3 474 9338
e. info@jacksons.co.nz

Filtration & Pumping Commercial Ltd (FPC)

Palmerston North - National Office

t. +64 6 358 1933
e. david@filtrationandpumping.co.nz