

SECTION 6 FILTRATION, POOL HEATING, WATER TREATMENT

LESSONS:

1. In specifying plant take a cautionary approach. An unnecessary outbreak or death is much more expensive than reasonably reducing the risk through non conservative filters, oversized pipes, bettering required turnover rates etc
2. Use quality products, be they plant or materials. They pay back far more than their marginal cost in reliability, increased efficiency and extended life.
3. Install proven heat recovery systems. Those that did have already paid for them and those that didn't are now having to retrofit at greater cost.

General

This section covers a very important function of swimming pools. Filtration, heating and treatment of the pool water are the aspects most noticed by and in many cases, complained of, by pool users. (Too hot, too cold, stuffy air, sore eyes, and strange smells.)

Getting these areas right at the design stage will save considerable costs in the future. It is prudent to provide sufficient plant room area, not only for the original equipment and chemical storage, but also for replacement plant or for future development. Money spent on promotion is wasted if filtration, treatment and heating have been compromised, as the pool user can easily be deterred by poor water quality and an environment that is either too hot or too cold. No amount of promotional spin will entice clients back to a pool with poor water or air quality.

The review found a variety of filtration, pool heating and water treatment systems. All can be expensive to replace and are vital to the success of the facility, so getting them right should be a priority. The loadings anticipated for each of the pools within the facility will help determine the type of filtration plant to be selected. The busier the pool the faster the turnover rate required

Choosing the right filtration, heating and water treatment type for your facility can reduce running costs, customer dissatisfaction, health and safety issues and having to admit to mistakes. NZS 4441 (see section 10) sets out design guidelines in these areas but because this standard is, in my view, out of date caution is recommended in following flow and filter turnover rates.

Filtration and Circulation

Water treatment can be separated into two distinct categories, mechanical and chemical. Mechanical treatment deals with filtration and circulation whilst chemical treatment deals with all microbiological and organic contaminants and the mineral balance of water.

This section deals with mechanical treatment, filtration and circulation. This involves the pumping of heated and treated water into the various pools. The water then flows from the pool surface into overflow channels, through a strainer to trap hair, lint or other floating matter, into a balance tank or reservoir. The circulating pumps draw the water from here through the filtration and heating units and back into the pools. Pools with large water volumes may also require a return system from the side or bottom of the pool.

The turnover rate (the time it takes for the total pool volume to pass once through the filtration plant) is determined by the type of filter chosen and the type of pool being treated. Water volume of the pool and projected loadings also has a bearing on turnover rates. Pools with small volumes of water and high loadings require a faster turnover time than say a diving well. For example a small toddler's pool will require a much faster turnover rate than a separate diving well or a lap pool.

Generally speaking, the common faults found with the filtration system are undersized filters and undersized pipes between filter and pool. This can restrict the flow of water to and from the pool and can result in the N.Z. Standards guidelines not being met regarding the amount of time it takes to pass the total volume of pool water through the filter. (See section 10)

The four main methods of filtration are pressure sand, gravity sand, vacuum diatomaceous earth (DE) and pressure DE. Some older pools with sand filtration have had pressure DE systems added. This was done due to a number of outbreaks of cryptosporidium in public swimming pools in 1997 and the inability of sand filtration to deal with its removal without an intricate and expensive coagulant regime. This outbreak, introduced to the pools by affected clients, resulted in a number of clients, mainly children being infected. Pool closures were enforced by health authorities until an expensive testing regime cleared pools for reopening. In one case, Huia Pool, the closure was 7 days .

The most common form of filtration in recently built New Zealand swimming pools, (since the cryptosporidium outbreak) is one of the DE options, pressure or vacuum. The advantage of the vacuum system is that the system is open and the condition of the filter elements and their readiness for cleaning can be observed. Its disadvantage is that it requires more space than a pressure DE system and needs to be in a ventilated enclosure to prevent chlorine fumes affecting plant room electrics.

A pressure DE system is enclosed, requires less space and does not need ventilation. It can be added to a sand system as a polishing filter, this greatly increases the filtration efficiency. The disadvantage is that the filter process cannot be seen. Regardless of the

DE system chosen, the shorter the DE run (period of operation prior to having to replace the DE), the more expensive the system is to run. This cost is related to the size of the filter area and the number of elements installed.

Pressure and gravity sand systems are not as common today as they were prior to the cryptosporidium outbreak. This is because of the size of a cryptosporidium oocysts is 5-8 microns. Either DE system can filter to about 3 microns but sand, depending on the sand condition, filters in the 15-25 micron range. Sand filtration, on its own, is therefore of little use if cryptosporidium is introduced into the pool. Some modern pools (opened in the past 12 months) have a sand filtration system with a coagulant. However, as Huia Pool also had a sand filtration system along with a coagulant at the time of its crypto outbreak, it would appear that, in the event of a cryptosporidium outbreak at these pools, clients could be at serious risk (another reason why NZS 4441, the pool design code, is out of date as stand alone sand filtration is listed as a viable option).

Of the eleven pools visited the following filtration systems were installed:

- High pressure sand – one.
- Gravity sand - one.
- Vacuum DE - one.
- Pressure DE - six.
- Sand & Pressure DE combined – one.
- Vacuum DE (lap & teach pool) plus Pressure DE (toddlers & spa), both at the same site. - one

The most common fault in filtration provision, regardless of the type chosen, is under-sizing of the system. It is much cheaper to slightly oversize at the design stage than have to remedy under sizing at some time in the future. A major problem could arise if a filtration system is designed to just meet anticipated loadings but actual loadings are higher than anticipated.

It is also important to select pumps and electric motors capable of doing the job. Installing inferior quality motors has resulted in a very short working life. Purchasing a superior quality circulating pump, for example, may mean around an extra \$1,000 in the purchase price of an \$8,000 to \$10,000 pump, but will result in up to eight years of additional use. Examples were found during this exercise of savings in the mechanical services contract by the installation of lesser quality plant equipment.

The installation of pipe work to and from the filter and the pool is an equally important consideration. It is cheaper, initially, to bury pipes under concrete but expensive to resolve any broken or leaking pipe situation. Another option is to house the pipe work in easily accessible tunnels. This system is often used when the pool inlets are at the sides of the pool rather than a central sparge inlet pipe. Examples were seen during the review of pipes buried under the pool concourse having to be dug up to repair leaks and of easy tunnel access to pipes at two other sites. One site had a tunnel, to carry pipe work to and

from the pool, but for some reason this was backfilled with sand. When a leak necessitated repairing the pipe, it was a major job because the sand had to be dug out first.

If selecting DE filtration, adequate provision must be made for storage of the filter media (25kg bags) along with the associated mixing tank for both vacuum and pressure systems. The lack of easy access to the plant room, storage and mixing areas, to accommodate the delivery of chemicals, was a problem at half the sites visited. At one site no provision had been made for the storage of chemicals (DE filter) but a mixing tank was provided. This resulted in the carrying of DE bags from one end of the plant room to the other across pipes in order to reach the mixing tank.

As mentioned earlier, the pool circulating pumps need to be of a superior quality as a breakdown could result in pool closure. Speed controls for circulating pumps have advantages and disadvantages. They are sometimes installed to reduce water flow due to poor pipe layout or undersized pipes which had previously resulted in serious pipe vibration. This however reduces turnover time.

As learner, lap and some leisure pools require different pool turnover rates, separate filtration systems will be required for each pool. This also applies if different pool water temperatures are required. An advantage of separate plant for learner and toddler pools is that in the result of a faecal accident that pool can be isolated rather than having to close the entire facility.

Pool Heating

The main types of heating systems are heat pumps, extracting heat from either outside air or an external water source and gas fired boilers.

Seven of the sites visited were in the South Island where bulk natural gas is unavailable so one of the heat pump types was used. The exception was the Moana leisure pool which uses an LPG fired boiler. All four North Island pools used natural gas fired boilers for pool heating.

In choosing a pool water heating system, consideration must be given to what is available in your location and which system best suits the needs of your facility. The method of heating the pool hall is another important consideration when selecting your pool water heating system. (See Section 7)

One of the sites visited selected a heat pump extracting heat from a nearby stream. Unfortunately, due to a lack of prior investigation, insufficient water was in the stream during summer. This resulted in converting the heat pump to an air system.

The desired pool water temperature, with adequate provision for more or less heat, needs to be allowed for at the design stage. The inability to heat toddler, learner and hydrotherapy pools to satisfactory temperatures can be an embarrassment, but no problems in this regard were experienced by pools taking part in this review.

Water Treatment (Chemical)

Many factors affect water treatment including pH control, alkalinity and the general quality of the water source for the pool. This section only deals with the treatment systems commonly in use in New Zealand. It is important to ensure that staff using the various treatment systems available are trained and qualified to deal with the systems and also all aspects that affect good water quality. It is a requirement of NZS 5826 that pool operators hold a NZQA unit standard. My distinct impression was that this requirement was the exception rather than the rule.

The disinfection process involves the addition of a sanitising agent to the pipe line from the filter to the pool (post chlorination) or directly to the balance tank (pre chlorination). The amount of "chlorine" added is determined by pool loadings and whether some other form of disinfection is also used. (Chlorine levels are set out in NZS 5826, the operational standard)

Disinfection systems found in this review were one, or a combination, of the following:

- Gaseous chlorine.
- Sodium hypochlorite.
- Salt chlorine generation.
- Ozone
- Ultra violet light (UV), a recent development in regard disinfection systems. No comment is offered on UV as none of the pools evaluated as part of this exercise used UV. It is however reputed to reduce chloramines that produce the sickly "chlorine" smell many swimmers complain of.

Some form of chlorine must be used in conjunction with ozone and UV, although NZS 5826, the operational standard, does not state to what level. In addition, a pH correction agent, commonly CO₂, is also usually required.

Of the sites visited the following systems were in use:

- Gaseous chlorine - one.
- Gaseous chlorine with ozone - one.
- Sodium Hypochlorite - two.
- Salt chlorine generation - three.
- Sodium Hypochlorite with ozone - four.

One facility changed from sodium hypochlorite to salt chlorine generation due to transport costs. An additional saving was made, as this change eliminated the purchase of up to seven CO2 cylinders per week.

It was obvious that some facilities had poor water circulation resulting in dead spots, the disinfection being used is not being adequately mixed in the pool water. All of these had a central sparge inlet system. This circulation deficiency affects the filtration, chemical content and thus the microbiological safety and the aesthetics of the pool's water and can be easily identified by green algae growth on the pool floor or walls. Such "dead spots" and any algae growth present health and safety concerns to both clients and staff.

Using independent testing laboratories to regularly check each body of pool water by bacteriological tests will give a clear picture of the efficiency of your water treatment regime and or your mechanical plant.

RECOMMENDATION:

That SPARC lobby Standards New Zealand to urgently upgrade NZS 4441 to meet the improvements in pool and plant design, water treatment and health considerations of the past thirty odd years.