# REDUCING WATER CONSUMPTION (II)

EARTHCHECK

## COOLING TOWERS, POOLS & LANDSCAPING

**There are many areas within a tourism operation that consumes water. This fact sheet focuses on how you can reduce water consumption in facilities common to many tourism operations such as cooling towers, pools and landscaping. Opportunities to reduce water use range from optimising equipment functionality, to installing alternative water sources such as rainwater tanks, effectively treating water and planting local plant species that are adapted to local climate conditions.**

### COOLING TOWERS

Cooling towers are heat removal devices that tourism operators use to remove heat from the hot refrigerant gases of large walk in refrigerators, freezers or air-conditioning units or to cool kitchen equipment such as jacket kettles.

Cooling towers are basically one or more basins through which heated water (used for cooling equipment) is cooled down. Gravity pulls the water down through the basin which contains 'fill' that allows the water to spread out in a cascade to increase the cooling area. At the same time a moving air stream (a natural air draft or mechanical fans) blows cool air over the water which causes a small portion of the water to evaporate which cools the rest of the water stream. The cooled water is then circulated back to the equipment to absorb more heat.

When the water evaporates it leaves salts and minerals that if allowed to accumulate in the basin, can cause biological growth, scale and corrosion. These are removed through a process called 'blowdown' (or 'bleed') where some of the circulating cooled water is removed which is then replaced with fresh 'make-up' water.

Under normal operating conditions, water is lost through evaporation and blowdown, however, if towers are not carefully maintained and operated they can waste large amounts of water, energy and chemicals.

### TIP

It is essential that no changes are made to cooling towers without first consulting your cooling tower service provider. It is very important that they understand that water, energy and chemical efficiency is a priority. Consider drawing up performance based contracts related to reducing water and energy consumption while still keeping fouling, scale and corrosion at acceptable levels. All reports should explain the purpose of all water treatment regimes and the related costs or savings.

Make sure you understand your system so you can properly analyse any test results. Sometimes it is even valuable to undertake independent testing to verify the performance of your cooling tower. Below are some ideas you could start discussing with your service provider and maintenance staff.

**Reduce the cooling load**

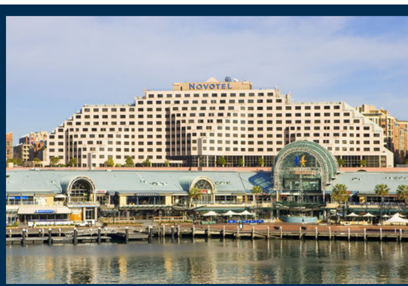
The first step to reducing water consumption in cooling towers is to reduce the cooling load. Reducing the cooling load placed on a cooling tower can save considerable amounts of water. Try raising the set temperature of air conditioning systems or reducing their operating hours.

**Reduce unnecessary water loss**

***Excessive overflow***

Cooled water collects at the bottom of the basin before being pumped back to the equipment needing cooling. To ensure the basin does not overfill with water, a ball float (similar to those used in toilet cisterns) is set at a predetermined level. If the water rises above this level it drains through an overflow pipe. Regularly check that there is not an excessive flow from this overflow pipe which may be the result of:

- The ball float being set to high
- The make-up pipe has been left on or is leaking
- The overflow drain pipe is leaking
- The water levels in connected basin are not equal causing water to flow to the basin with the lowest water level



### CASE STUDY:

**Novotel Sydney, Darling Harbour Australia**

**Novotel Sydney replaced one of the two cooling towers used to remove heat from the Hotel's air conditioning plant with an air cooled system.**

Previously, on hot days the cooling towers were consuming up to 30% of the Hotel's total water consumption. Although very efficient, any increase in energy consumption by the air cooled system has been recouped in water, maintenance and chemical savings. The remaining cooling tower is connected to the air cooled chiller and now only cuts in during hot weather when demand is high. In addition, blowdown from the cooling tower has been automated using a conductivity probe ensuring water is purged only when predetermined levels of dissolved solids have been reached, saving both water and staff time.

***Excessive splash***

Excessive splashing from the tower may indicate that the flow of water being fed into the tower needs to be reduced or the speed of cooling fans is too high. If the tower is located in a windy area water may also be blown out of the tower and a wind break or anti-splash louvers should be installed.

***Excessive drift***

When the water evaporates it can also carry out tiny water droplets called drift. If drift is excessive, drift eliminators can be installed or existing eliminators repaired.

***Leaks***

It is essential that the basin along with any connections and pumps are checked regularly for leaks. It is a good idea to install meters on both the make-up and blowdown pipes to identify normal patterns of consumption so any abnormalities can be identified quickly. These can be connected to a Building Management System (BMS) so management can be alerted immediately.

### *Excessive blowdown*

Blowdown to remove contaminants, salts and minerals can be done manually by staff at set intervals or automatically using a timer or conductivity probe. Conductivity probes measure the amount of total dissolved solids in the basin water and will only initiate blowdown when it is required, saving water and staff time. If your tower has a conductivity probe already installed, make sure it is cleaned and calibrated regularly.

Conductivity probes also make it possible to set total dissolved solid levels (**cycles of concentration**). Once this level is reached, it triggers the system blowdown.

Cycles of concentration compares the levels of dissolved solids in the blowdown water with the level of dissolved solids in the incoming fresh make-up water. For example, cycles of concentration =

$$\frac{\text{Total dissolved solids in the blowdown water} = 6}{\text{Total dissolved solids in the make-up water} = 2} = 3$$

By increasing the number of cycles it is possible to reduce the amount of blowdown and thus the need for make-up water. The optimum cycles of concentration is influenced by the quality of make-up water, corrosion resistance of the tower basin and the equipment it is cooling e.g. air conditioning condenser. The ability to increase the cycles of concentration often relies on effective **water treatment** that can help reduce corrosion and scale build up.

Possible cooling tower water treatment options include:

- Pre-treating make-up water using water softeners to precipitate out ions such as calcium and magnesium or reverse osmosis to remove ions
- Direct dosing with chemicals such as phosphonates, polymers and organic corrosion inhibitors that prevent scale and corrosion
- Acid dosing to keep ions in solution to control pH and scale
- Microbial treatment or ozone dosing to prevent the growth of harmful bacteria such as Legionella
- Side stream filtration (e.g. centrifugal separation and sand filtration) to remove suspended solids

### Alternative cooling tower water sources

Consider alternative water sources such as recycled water, rainwater or even air conditioning condensate that could substitute or supplement cooling tower make-up water. The key issues to consider when assessing potential alternative water supplies include:

- Water quality
- Quantity and consistency of supply
- Health and safety

### Reuse cooling tower blowdown water

Investigate if there are opportunities to use cooling tower blowdown water for toilets and urinal flushing, landscaping or cleaning. Before proceeding, fully investigate if any further treatment would be required to eliminate any health risks or water quality issues. The water may need to be diluted (e.g. with harvested rainwater) to prevent corrosion or scale build up on infrastructure such as pumps and pipes.

### Replace cooling tower with air chillers

If the region is particularly water constrained, tourism operations could consider replacing water cooling towers with air chillers, however additional costs in energy may need to be considered.

## Pools

Pools and spas are an important part of many tourist destinations however it is essential that they are managed carefully to prevent unnecessary water wastage. Pools require make-up water to replace water lost through leaks, evaporation, backwashing (to flush out the filter) and splash.

### Cracks and leaks

Conduct regular inspections of the pool to identify leaks and undertake repairs immediately (see *Factsheet 4: Monitoring and leaks*). As leaks may not be visible it is best to install sub-meters on the make-up lines. If the meters are read frequently any excessive water consumption will be identified early.

### Optimize backwashing

Link backwashing to a filter pressure gauge which will electronically initiate backwashing when necessary. If backwashing is carried out manually, investigate if it is possible to decrease the frequency while still remaining within the limits of health codes. Only backwash your filter until the water runs clean. If necessary install a clear view screen into the backwashing hose. Investigate if it is possible to reuse the backwash water for non-potable applications such as irrigation.

### Reduce evaporation loss

Pool covers greatly reduce evaporation however they may not be suitable for operations requiring extended hours of pool access. They should however be considered for cooler periods when the pool may not be in use. They are also extremely effective in reducing heat loss from heated pools when used overnight. The temperature of heated pools should be kept as low as possible, while still meeting the needs of guests, to help reduce evaporation while also saving energy and chlorine costs.

Another alternative is to provide shade to reduce evaporation as well as to provide shade for guests. This could be as simple as placing a number of umbrellas around the pool, or a shade cloth covering the entire pool area. Pools situated in a windy location should also consider installing a barrier or planted trees to reduce evaporation, making sure visibility for pool safety is not compromised.

### Reduce splash loss

Install drainage barriers around the pool to collect splash and overflow. These drains feed the water back into the pool. If possible, avoid overfilling the pool which will only increase splash and overflow losses. Keep the operation of waterfalls, water features and slides to a minimum to avoid fine sprays that are also easily lost to evaporation.

### Alternative water sources

Install a rainwater tank to help supplement pool make-up water.

Meliã Bali, Indonesia

## LANDSCAPING

Beautiful landscaping is extremely important for welcoming guests and adding to the enjoyment and relaxation of their visit. Gardens should be healthy and well designed to save both water and labour.

**Understand your gardens watering requirements**

Watering schedules that remain constant all year round will typically over water or under water plants and lawns. Make sure watering schedules take account of seasonal variations, vegetation types and daily weather conditions.

Keeping a rain gauge or using a soil moisture sensor will help determine if gardens have received enough water through natural rainfall while a rain sensor will ensure automatic irrigation systems turn off when it is raining. It is also essential to have a good understanding of the soil. A soil analysis can provide useful information on any soil amendments required to provide plants with nutrients and help retain water.

**Water efficient irrigation**

Avoid irrigating gardens during times when high evaporation is likely to occur, such as the middle of the day. More appropriate times are late at night or early in the morning. Timers can be used to ensure gardens and lawns are watered at the right time and for the correct length.

The most efficient option is to install an automatic control system that will adjust irrigation rates according to local weather conditions and soil moisture levels. When watering make sure plants receive a thorough soaking, rather than more frequent light surface watering, so as to encourage deeper root growth.

Ensure that water goes directly to the roots and is not lost to runoff and/or overspray. Drip or soaker irrigation systems that are close to the ground or subsurface are ideal. Installing a meter in your irrigation system will help identify leaks and excessive water consumption quickly. Make sure all hoses used for watering or cleaning outside have trigger nozzles that shut off water automatically.

**Plant water efficient gardens**

It is always best to plant species that are local to the region. These plants are not only adapted to your region's climate and soil but will also support local wildlife. Always avoid planting invasive or environmental weeds. Plants should be grouped with other plants of similar water requirements to avoid some plants being overwatered. Adding mulch to gardens will also reduce the water needs of your gardens by reducing soil evaporation while also breaking down to add nutrients and organic matter to help improve soil water retention and structure.

Soils that are particularly water constrained could benefit from wetting agents (that penetrate the organic coating of soils that repel water) or water gels (that absorb large amounts of water that can be later released).

**Alternative water sources and wastewater treatment**

Investigate alternative water sources for irrigating gardens. Options include rainwater diverted from gutters and storm water drains or collected in dams or tanks and recycled water including grey water from showers and laundries, treated sewage, cooling tower blowdown water, pool backwash water and condensate from air conditioning systems.

There may be local restrictions on the use of recycled water so check with your local authority and environmental agency. It is likely that the use of recycled water for irrigation will require irrigation hardware to be adapted e.g. nozzles that will not clog and wastewater treatment.

Wastewater treatment can involve a number of steps with each additional step improving some aspect of the wastewater. The number of steps required will be based on the quality of the wastewater required for the end use. The five main steps are:

- ***Pretreatment*** to remove bulk material such as using screens to remove objects from the surface and pH adjustment
- ***Primary treatment*** to remove material that floats such as oils and greases and organic and inorganic solids that settle as sludge. This could involve using clarifiers that use gravity settling for sludge and floatation and dissolved air flotation (DAF) systems that use air to float insoluble material like fats and oils to the surface where it can be removed
- ***Secondary treatment*** removes organic matter and some nutrients such as nitrogen and phosphorus. These include anaerobic systems that allow bacteria (in the absence of oxygen) to breakdown high strength organic waste into methane, carbon dioxide and inert biological cells. Aerobic systems use bacteria to breakdown low strength organic waste, but in the presence of oxygen, provided through an artificial aeration system. The cells settle as sludge in a clarifier or pond

### CASE STUDY:
**The Taj Residency, Bangalore India**

The Taj Residency Hotel sends all of its effluent and pool backwash water to a Single Phase Biological Treatment plant. In an aeration tank the effluent is supplied with air to create a highly oxygenated environment suitable for bacteria that use the organic matter in the effluent as an energy source. Unfortunately the bacteria cannot digest all of the solids in the effluent and these solids eventually settle out as sludge. This sludge is sent to rotational contractors for further treatment. The treated water from the aeration tank overflows to a settling tank where the microbes that have treated the wastewater settle out of the water. This bacterial sludge is reticulated back into the aeration tank to help maintain the bacterial population.

The treated water then undergoes a tertiary treatment to improve its quality by being fed though a sand and activated carbon filter. The treated water is used for irrigating the hotel's gardens and cooling tower. This ambitious wastewater recycling project cost the hotel around AUD$95,000 to purchase and install and **saves around 15-20 kilolitres of water per day,** in addition to reducing energy costs that were being incurred pumping raw water from bores. Any unused treated water is sent to the municipal sewage treatment plant.

- ***Tertiary treatment*** removes any organic and inorganic material that resists the primary and secondary treatment to produce high quality water for reuse. This type of treatment includes the use of membranes (micro- filtration, ultra-filtration, nano-filtration and reverse osmosis), filtration through filter beds, chlorination, ultra violet disinfection, ion exchange, ozonation and adding chemicals that will cause substances to precipitate out of the solution