5.4 Commercial Pool and Spa Equipment

EPA WaterSense

Overview

Pools and spas are found in many commercial or institutional settings, including hotels, schools, community centers, hospitals, and apartment complexes. The size and features of these pools vary widely depending on their intended use and setting. Table 5-1, which summarizes typical pool sizes for commercial pools and spas in California,[47] shows that a typical commercial pool can contain between 34,000 and 860,000 gallons of water. Spas are much smaller, containing on average 1,100 gallons. Due to a lack of data, the California Urban Water Conservation Council (CUWCC) document from which this data was taken assumes that the typical pool sizes estimated for California are representative of pool sizes nationally.

Table 5-1. Typical Sizes for Commercial Pools and Spas

Pool Type	Area (square feet)	Depth (feet)	Volume (gallons)
Spa	40	3.0	1,100
Hotel (in-ground)	1,000	4.5	34,000
Public (in-ground)	4,000	5.0	150,000
Olympic (in-ground)	14,000	8.0	860,000

Overall, a large volume of water is used to fill commercial pools or spas. Much of this water is often lost in day-to-day operation due to evaporation, leaking, and splashing. Ongoing pool or spa maintenance also creates significant losses in filter cleaning and mineral buildup control.

Because evaporation, filter cleaning, and mineral buildup control represent the greatest uses of water for commercial pools and spas, they also provide the most significant opportunities to achieve water savings. CUWCC estimates that water evaporation, filter backwashing, and mineral buildup control account for 56, 23, and 21 percent of pool water use, respectively, across all pools installed in California.[48] Water losses from leaks and splashing are not included in this estimate because they are difficult to quantify. Although the estimates used in this section are specific to California, EPA assumes that, with the exception of evaporation (which is dependent upon local climate), they are applicable to and representative of pools and spas nationwide.

Evaporation

Water continually escapes pools and spas due to evaporation from the pool/spa surface. The rate of evaporation will depend upon several factors, including: water temperature, the pool's ambient conditions (e.g., indoor or outdoor), the extent of convection over the pool's open surface, and the surface area of water that comes in

[47] Koeller, John and H.W. (Bill) Hoffman & Associates, LLC. September 2010. *Evaluation of Potential Best Management Practices—Pools, Spas, and Fountains*. Prepared for the California Urban Water Conservation Council. Pages 3-30. www.cuwcc.org/products/pbmp-reports.aspx.
[48] *Ibid*. Page 30.

contact with air. Table 5-2 provides an overview of evaporation losses for various pool sizes, as estimated by CUWCC.[49] These estimates show that water losses from evaporation can be significant. For example, the total volume of water lost annually in spas is several times larger than the volume of the spa itself. For larger pools, this effect is reduced; however, the water loss still can be significant and of the same order of magnitude as the volume of the pool itself.

Table 5-2. Evaporation Water Losses by Pool Type

Pool Type	Pool Volume (gallons)	Water Loss (gallons per year)
Spa	1,100	6,300
Hotel (in-ground)	34,000	40,000
Public (in-ground)	150,000	160,000
Olympic (in-ground)	860,000	570,000

Filter Cleaning

All swimming pools require pool filtration systems in order to keep the water free of particulate matter. These systems include pumps, filters, drains, and skimmers. In terms of water efficiency, the distinguishing factors are the type of filter and the amount of maintenance associated with it. The other components of the filtration system have little impact on water use.

Pool filters are differentiated by the media used to treat pool water. These media primarily include sand, sorptive media (i.e., pre-coat filters), and cartridge filters. While these filter types operate on the same principle of circulating water through filter media to separate suspended particles, their design differences affect how often they need to be cleaned, which in turn affects how much water they use. Each type requires a trade-off between water and material use efficiency.

Pool and spa filters must be cleaned on a regular basis to maintain efficiency. As debris builds up on the filter, water flow becomes restricted and reduces filter efficiency, performance, and sanitation. For this reason, filters must be cleaned regularly. The rule of thumb is that filter cleaning is necessary after the filter pressure has increased by 5.0 to 10.0 pounds per square inch (psi).[50]

Pool operators must backwash sand and sorptive media filters to clean them. During this process, water is run backwards through the filter to remove the accumulated debris and particulates from the filter media. The filter backwash water is typically drained to sanitary sewer lines.[51]

Sand filters are composed of silica sand, zeolite, or crushed recycled glass, while sorptive media filters have a diatomaceous earth, cellulose, or perlite base. Sand filters can be backwashed several times before the media must be

Commercial pool

[49] *Ibid*. Page 10.
[50] *Ibid*. Page 19.
[51] Southern Nevada Water Authority. How to Drain a Pool or Spa. www.snwa.com/land/pools_drain.html.

replaced, but they use the greatest amount of water to flush particulates out of the sand in the backwash process. Sorptive media filters use less water, but must be replenished after every backwash, as the media is purged from the filter grid along with the debris. Replenishment is accomplished by mixing new sorptive media with water and pouring it into the skimmer closest to the pump. The pump then transports the sorptive media to the filter and deposits it onto the filter grid.

Cartridge units eliminate backwashing by using pleated filters made from a paper-type material that can be reused or disposed. Instead of backwashing, disposable cartridge filters are removed, discarded, and replaced with a new filter. Reusable filters are rinsed with a spray hose or soaked in a cleaning solution before being brushed or rinsed. While cartridge filtration is the most water-efficient, it is not usually a viable option for large commercial pools because the cartridge replacement rate quickly becomes cost-prohibitive and labor-intensive.[52]

Large commercial pools sometimes use a fourth filter type, industrial filters, which are a specific type of sorptive media filter. These filters are more efficient than traditional sorptive media filters because they can recycle the sorptive media up to 30 times before it must be discarded and replaced. Unlike traditional sorptive media filters, which pass water straight through the filter during backwashing, industrial filters recycle the water that is used to backwash the filter. As a result, the total volume of water used during backwashing is reduced to only twice the volume of the filter.[53]

The East Bay Municipal Utility District in Oakland, California, recommends using sorptive media for commercial pools and cartridge filters for spas.[54] Table 5-3 provides an overview of the water use associated with each filter type, as estimated by CUWCC.[55] These estimates show that, for smaller pools and spas, cartridge filters use less water than sand, sorptive media, or industrial filters. For larger pools, industrial filters are much more efficient.

Table 5-3. Filter Cleaning Water Consumption Estimates by Pool and Filter Type

Pool Type	Pool Volume (gallons)	Water Use (gallons per year)			
		Sand	Sorptive Media	Cartridge	Industrial
Spa	1,100	940	470	300	N/A*
Hotel (in-ground)	34,000	30,000	9,400	3,600	5,000
Public (in-ground)	150,000	170,000	42,000	N/A	9,000
Olympic (in-ground)	860,000	960,000	240,000	N/A	17,000

*N/A: not applicable

[52] East Bay Municipal Utility District (EBMUD). 2008. *WaterSmart Guidebook—A Water-Use Efficiency Plan Review Guide for New Businesses*. Page 171. www.ebmud.com/for-customers/conservation-rebates-and-services/commercial/watersmart-guidebook.
[53] Koeller, John and H.W. (Bill) Hoffman & Associates, LLC, *op. cit.*, Pages 18-19.
[54] EBMUD, *op. cit.*, Page 174.
[55] Koeller, John and H.W. (Bill) Hoffman & Associates, LLC, *op. cit.*, Page 35.

Mineral Buildup Control

Water in pools and spas experiences a continual buildup of dissolved solids in the form of mineral salts and treatment chemicals. This buildup must be treated or removed to prevent scale buildup or corrosion of pool surfaces and equipment. Proper pool maintenance and water quality control are essential for extending the useful life of the water. Water quality control significantly saves water by reducing the number of times the pool must be completely drained and refilled, the number of filter backwashes needed, and the potential for leaks due to corrosion or other factors.

All pools require water to be exchanged periodically in order to control the buildup of solids and other contaminants. This water exchange can be either partial or full and can be controlled manually or through an automated process. When draining the pool manually, the pool operator will simply pump pool water directly to the drain at some predetermined point in time. The automated approach utilizes conductivity controllers, which drain a portion of the pool water once a predetermined concentration of total dissolved solids is reached. Conductivity controllers save water by limiting exchanges to when they are necessary. The amount of water lost in the exchange process will depend upon pool volume, dissolved solids concentration in the make-up water, type and amount of treatment chemicals added, and the local evaporation rate.[56]

Reverse osmosis systems, which operate independently from pool filters, are also utilized to prolong the useful life of pool water. During reverse osmosis filtration, pool water is passed through a membrane filter, which selectively excludes dissolved minerals and suspended particles from passing through the filter. Water is able to permeate through the barrier and is recovered and returned to the pool. The dissolved minerals and suspended particles that are trapped behind the membrane filter are then discharged to sanitary sewer lines as reject water. Recovering the pool water in this manner eliminates the need to dump and refill the pool. While reverse osmosis systems are effective at filtering minerals, they waste a large amount of water in the treatment process. A large facility should consider the amount of reject water that would be produced if utilizing this equipment.

Leaks and Splashing

Water is lost in pools and spas from leaks and splashing throughout their useful life. Common leak locations include pump seals, pipe joints, piping in filtration system suction or return lines, pool liners, and along pool edges. A leak may be present if a pool is losing more than two inches of water per week. Air bubbles in either the pump strainer basket or water return line can also indicate the presence of a leak.[57] Water is also lost during pool use from splashing and drag-outs as swimmers exit. Water loss from drag-outs can be mitigated by the use of gutter and grate systems installed along the edge of the pool. Although leaks and splashing contribute to water loss, it is difficult to quantify the frequency and extent to which they can occur.

[56] *Ibid*. Page 15.
[57] *Ibid*. Page 12.

Operation, Maintenance, and User Education

Controlling evaporation, splashing, leaks, and mineral buildup and ensuring that filters are cleaned properly are important operation and maintenance measures to ensure commercial pool and spa equipment efficiency.

Evaporation

To control evaporation, consider the following:

- Do not heat pools above 79°F to reduce water evaporation rates.[58]
- Limit the use of sprays, waterfalls, and other features.[59]
- Use pool covers to reduce evaporation rates during periods in which the pool is not in use. Covers also prevent debris from entering the pool, which in turn leads to reduced water usage from filter backwashing.[60]
- As an alternative to pool covers, liquid barriers can be used to control evaporation. These alcohol-based chemicals prevent evaporation by forming a thin film along pool surfaces that acts as a barrier.[61] Liquid evaporation barrier products are available through pool supply vendors.[62]

Splashing

Splashing contributes to water loss. To reduce the amount of water loss from splashing, set the pool water level to several inches below the edge of the pool.[63] In addition, plug the overflow line when the pool is in use or when adding water.[64]

Filter Cleaning

Filter cleaning represents the greatest use of water attributed to pools or spas. Although water use depends upon the type of filter system installed and the extent to which the pool is used, consider the following:

- Clean filter media only as necessary and not on a set schedule (i.e., clean only when the filter is no longer operating effectively). Although there are several methods by which effectiveness is measured, the typical rule of thumb is that filter cleaning is necessary after the filter pressure has increased by 5.0 to 10.0 psi.[65]
- Utilize the sight glass if one is installed to monitor the visual quality of the backwash water running through the filter and determine when backwashing is complete, rather than backwashing for a predetermined set amount of time (e.g.,

[58] Alliance for Water Efficiency (AWE). Swimming Pool and Spa Introduction. www.allianceforwaterefficiency.org/Swimming_Pool_and_Spa_Introduction.aspx.
[59] Koeller, John and H.W. (Bill) Hoffman & Associates, LLC, *op. cit.*, Page 33.
[60] *Ibid.*
[61] *Ibid.* Page 34.
[62] Williams, Kent. Professional Pool Operators of America. November 2002. "Liquid Pool Covers Save Energy." *Pumproom Press*. # 25. www.lincolnaquatics.com/Documents/7536.pdf.
[63] Koeller, John and H.W. (Bill) Hoffman & Associates, LLC, *op. cit.*, Page 13.
[64] AWE, *op. cit.*
[65] Koeller, John and H.W. (Bill) Hoffman & Associates, LLC, *op. cit.*, Page 19.

five minutes). Backwashing is complete once the water that passes through the sight glass is clear and free of particulates.

Mineral Buildup Control

Pools and spas must be drained of some water on a regular basis in order to control the mineral salt concentrations that gradually build up. The frequency of these events can be reduced by prolonging the useful life of the water by considering the following:

- Maintain proper pH, alkalinity, and hardness levels to avoid the need to drain the pool or to avoid using excess make-up water to correct water quality issues.
- When draining the pool, perform a partial drain rather than a full drain. Consider using the drained pool water for irrigation or other purposes. See *Section 8: On-site Alternative Water Sources* for more information.[66]

Leaks

To check your pool for leaks and prevent them for occurring, actively monitor the pool's water levels. If the pool is losing more than two inches of water per week, it could be leaking.[67] In addition, actively monitor for leaks around the pump seals, pipe joints, piping in filtration system suction or return lines, pool liners, and along the pool edges. Repair leaks as soon as they are identified.

Retrofit and Replacement Options

If retrofitting an existing pool or spa, there are a several options to minimize overall water use by addressing evaporation, filter cleaning, mineral buildup control, leaks, and splashing. If designing a new or replacement pool or spa, use the management techniques listed in the previous section and the equipment options below.

Evaporation

To prevent water loss from evaporation, cover the pool when it is not in use. In addition, consider the following to control the evaporation of pool or spa water:

- Reduce wind movement across the water by using fences, walls, non-shedding hedges, or other similar barriers.
- Use a liquid barrier. These alcohol-based chemicals prevent evaporation by forming a thin film along pool surfaces that acts as a barrier.[68] Liquid evaporation barrier products are available through pool supply vendors.[69]

[66] *Ibid*. Page 15.
[67] *Ibid*. Page 12.
[68] *Ibid*. Page 34.
[69] Williams, Kent, *op. cit.*

Filter Cleaning

In addition to the operation and maintenance tips outlined in the previous section, consider the following for optimum filter efficiency:

- Install a pool filter pressure gauge. This will provide a means for determining when filter cleaning is necessary (i.e., after a pressure increase of 5.0 to 10.0 psi).
- Install a pool filter sight glass to provide a visual means for determining when backwashing is complete and minimize the backwashing time.
- If replacing existing filtration systems, consider installing cartridge filters for small pools and spas, sorptive media filters for medium-sized pools, or industrial filters for very large pools.

Mineral Buildup Control

To control mineral buildup, consider the following:

- Install a reverse osmosis system to prolong the useful life of pool water and to reduce the number of times that the pool must be drained in order to control the concentration of dissolved solids.
- Install a conductivity controller system to manage the concentration of dissolved solids in the pool. This system will monitor the buildup of dissolved solids so that at a predetermined level, a portion of the pool water can be drained and replaced, rather than the entire volume. This also offers the added benefit of providing a frequent source of water that can be used for irrigation or other purposes. See *Section 8: Onsite Alternative Water Sources* for more information.[70]

Leaks

To reduce water loss from leaks, install a water meter to the pool's make-up line. This will provide a means for directly monitoring and tracking water use for signs of potential leaks.

Splashing

To reduce water loss from splashing, install pool gutter and grate systems along the pool perimeter to mitigate drag-out losses during pool use.

Savings Potential

Significant water savings can be achieved through proper pool and spa operation and maintenance and other water-efficient technologies. Following are a few examples of savings that can be realized from implementing water-efficient practices or technologies in pools or spas:

[70] Koeller, John and H.W. (Bill) Hoffman & Associates, LLC, *op. cit.*, Page 15.

- USA Swimming estimates that using pool covers overnight at heated, commercial indoor swimming pools can save approximately 575,000 gallons of water per year and also provide energy savings.[71]
- CUWCC estimates that evaporation losses can be reduced by 30 to 50 percent by using pool covers and 10 to 30 percent with liquid evaporation barriers.[72] For an Olympic-sized pool, this could save as much as 290,000 gallons per year.
- CUWCC estimates that replacing conventional sand and sorptive media filters with cartridge or industrial filters, where appropriate, can save between 68 and 98 percent of backwash water. For an Olympic-sized pool, replacing sand filters with industrial filters could save as much as 940,000 gallons of water per year.[73]
- CUWCC identified one manufacturer who reported that installing a reverse osmosis system could potentially reduce water consumption by saving 78 percent of the pool water that would otherwise be drained to control mineral buildup. For an Olympic-sized pool, this could save as much as 300,000 gallons of water per year.[74]
- Based on the CUWCC estimates listed above, the combined use of pool covers, cartridge or industrial filters, and reverse osmosis systems could provide a total annual water savings of as much as 1,500,000 gallons for Olympic-sized pools.

Additional Resources

Alliance for Water Efficiency. Swimming Pool and Spa Introduction. www.allianceforwaterefficiency.org/Swimming_Pool_and_Spa_Introduction.aspx.

East Bay Municipal Utility District. 2008. *WaterSmart Guidebook—A Water-Use Efficiency Plan Review Guide for New Businesses*. www.ebmud.com/for-customers/conservation-rebates-and-services/commercial/watersmart-guidebook.

Koeller and Company and H.W. (Bill) Hoffman & Associates, LLC. September 2010. *Evaluation of Potential Best Management Practices—Pools, Spas, and Fountains*. Prepared for the California Urban Water Conservation Council. Pages 3-30. www.cuwcc.org/products/pbmp-reports.aspx.

Marin Municipal Water District. Swimming Pool Tips. www.marinwater.org/controller?action=menuclick&id=268.

Poolmanual.com. *Pool Manual*. www.poolmanual.com/poolmanual.aspx.

Southern Nevada Water Authority. How to Drain a Pool or Spa. www.snwa.com/land/pools_drain.html.

State of California Department of Water Resources. 2012. *Commercial, Institutional and Industrial Task Force Best Management Practices Report to the Legislature*.

[71] USA Swimming. A Green Initiative Unique to Natatoriums. www.usaswimming.org/ViewMiscArticle.aspx?TabId=1755&Alias=rainbow&Lang=en&mid=7715&ItemId=3633.
[72] Koeller and Company and H.W. (Bill) Hoffman & Associates, LLC, *op. cit.*, Page 34.
[73] *Ibid*. Page 35.
[74] *Ibid*. Page 30.

USA Swimming. A Green Initiative Unique to Natatoriums. www.usaswimming.org/ViewMiscArticle.aspx?TabId=1755&Alias=rainbow&Lang=en&mid=7715&ItemId=3633.

Williams, Kent. Professional Pool Operators of America. November 2002. "Liquid Pool Covers Save Energy." *Pumproom Press*. # 25. www.lincolnaquatics.com/Documents/7536.pdf.