



The 411 on UV Disinfection for Pools and Spas

While ultraviolet light, or UV, has been used for treatment and disinfection of water for decades by many municipal and commercial pool entities, it is only in the past few years that the technology has been embraced by the pool and spa industry in the U.S. By now, most people are familiar with the term and understand that a UV system can disinfect water, but that is usually where the understanding ends. Fortunately, the basic principle is fairly simple and you don't need to be a chemist to say "I get it now."



UV 101

Ultraviolet light is a spectrum of light just below the range visible to the human eye. It is divided into four distinct spectral areas: Vacuum UV(100-200nm); UV-C(200-280nm); UV-B(280-315nm); and UV-A(315-400nm). These spectral areas are very specific. UV-C(200-280nm), known as the germicidal spectrum, is the most lethal range as a germicidal disinfectant. It is within this range that the DNA of a living microorganism can be altered, preventing it from reproducing and effectively inactivating it. UV-C radiation H used for disinfection is most effective at a wavelength of 264nm.

WHY USE UV?

Now that we know how germicidal disinfection occurs when microorganisms are directly exposed to UV-C light, why use UV when chemical methods such as chlorine, bromine or even salt generators have been around for years? While chlorine and other chemical methods are effective against many bacterium and viruses, they can be slow to respond to highly resistant chlorine protozoa such as *Cryptosporidium*, which can take as long as 6.5 days to disinfect. That is a long time. It also offers an explanation as to why there was a record number of reported Crypto outbreaks last year at facilities that not only met, but exceeded the local residual requirement.

In addition to UV's effectiveness in germicidal disinfection, there is also the added benefit of its ability to reduce chloramines, which are attributed to numerous skin and eye irritants as well as respiratory problems commonly associated with many pool and spa installations. Chloramines are formed as a product of nitrogen derived from, among other things, sweat, urine, cosmetics and feces, combined with chlorine based disinfectants, and are measured as combined chlorine.

Combined Chlorine=Total Chlorine minus Free Chlorine.
With the proper dose, UV can help reduce combined chlorine

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by breaking the N-CL bonds of the chloramine molecules. UV indirectly reduces chloramines because less chlorine is used when a UV system is in place, thereby reducing combined chlorine. Commercial operators will be able to stay as close to their state minimum requirement, typically 1-2 ppm, as opposed to the 3-5ppm usually practiced, and residential pool owners will be able to stay within the .5-1 ppm range.

While UV does an excellent job, it does have its limitations, and does not offer the disinfectant residual that chlorine-based disinfectants have. It is for this reason that codes that require UV still require a disinfectant that offers a residual. This practice is strongly recommended for residential applications, even though they are not subjected to the commercial codes.

UV SYSTEM DESIGN

While there are many reputable UV manufacturers in the market, many (even the reputable ones) do not make the effort necessary to properly size a UV system for a pool or spa application. Most of you know your pumps inside and out. If a pump manufacturer undersized or oversized a pump, you would call them out on it in a heartbeat. Choosing the right UV system is very similar in that regard. As a consumer, and a voice of your customer, it is your responsibility to ensure

that the manufacturer is doing more than just matching a dose with a flow-rate. You can even go so far as to ask them to send you their calculations for how their dose was determined. Don't worry about the fact that you may not have a clue as to how to read it. If the response is: "That's proprietary information," be suspicious. We'll go through a short list of criterion that will help you make your choice. Some of these overlap with each other, but it will all come full circle.

Required Dose: This depends on what you are trying to achieve. Two standard doses often used are 40mj and 60mj. A Fluence dose of 40mj ensures a 4-log reduction (99.99% inactivation of pathogenic bacteria and viruses). This would be the recommended dose for many outdoor and some indoor applications given that the rest of the criteria is understood. This dose will also reduce chloramines if the proper recirculation parameters are met. A Fluence dose of 60mj would have the same germicidal attributes as the 40mj dose, while having the added benefit of reducing chloramines in systems

with slower recirculation rates and/or indoor applications where improving air quality is necessary.

Type of pool/number of bathing guests: The following questions must be answered when choosing a proper UV system. The amount of people using the pool and what use the pool provides all affect the amount of sanitation needed. Is this for indoor or outdoor use? Is it a spa, wading, exercise or kiddie pool? Is this a residential pool with minimal bathers, or do the homeowners entertain often with large gatherings?

Volume of pool/turnover period: This is a crucial component that somehow is seldom asked, yet is a vital aspect that ties in the above criteria. Many know that it's necessary to provide the flow, typically in gallons per minute when specifying a UV system. This only paints a partial picture. Take, for example, a flow of 100 gpm. I have seen this flow used for large spas with a recirculation rate of 30 minutes, to small indoor commercial pools with a four-hour recirculation rate, to a large outdoor residential pool with a recirculation rate of eight hours. All of

these applications vary greatly in the other criterion already mentioned, i.e., dose, type of pool and number of bather guests. To recommend a UV system based solely on the flow is negligent and can be costly. If a system is undersized, there's the obvious risk that disinfection and reduction of chloramines are not occurring. If a system is oversized, then there's the unnecessary equipment expense associated with that.

UV-Transmittance: %UVT (Percent of UV Transmittance) is the percentage of UV light that can penetrate through 1cm of water. This is a vital factor used in the flow rate calculation and is probably the most crucial yet overlooked parameter by many substandard UV equipment manufacturers. Some of the factors that effect UVT are dissolved solids in the form of minerals or suspended solids such as debris from trees and leaves as well as suntan oils from the bather load.

As a general rule of thumb, 90 percent is often used as the accepted transmittance for pool and spa applications. Keep in mind that this is simply a rule

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of thumb. The dose delivered by the UV system is directly factored by the UV equipment manufacturers by the UVT percent. Simply put, if you request a UV system based on a 40mj dose and a UVT of 90 percent with a given flow, the unit will be undersized if the UVT turns out to be anything less than that. It is impossible to eyeball a water sample and say that the water is "good" or "clear." UVT is also not a one-to-one ratio with dose. If the UVT is 5 percent lower than expected, let's say 85 percent, you can't guesstimate that a unit specified to give a 45mj dose will even things out. The solution is simple. Call the UV manufacturer and request that it analyze a water sample at their facility. The test takes about five minutes, and a reputable manufacturer will do it free of charge. If they tell you it's not necessary or they don't have the equipment, hang up the phone. You're done with them.

UV MYTHS

UV is too expensive for the residential or small commercial market: UV systems have been manufactured for

decades with PVC materials and simplified controls at a fraction of the cost of many stainless steel units in the industry, without sacrificing functionality or effectiveness. If a stainless steel unit is preferred, then it must be 316L.

Chlorine will attack anything less than that at an accelerated rate, and your unit will need to be replaced in a short period of time. Also, do your homework on replacement lamps and electrical requirements. While comparative units may be similar in price, the price to operate a system for one to three years may differ by five to 10 times.

Chlorine consumption will increase: As mentioned earlier, a properly specified system will allow UV to handle the disinfection portion, reducing the demand for chlorine and utilizing it for its residual characteristics. UV will also stabilize the pool, eliminating the need to constantly "shock" it.

I need a wiping system: An efficiently manufactured UV system does not need a wiping system to clean the quartz sleeves in the unit. Aside from adding 20 percent to 40 percent to the cost of a

system, studies have shown that a wiping system often scratches the quartz sleeves, which lowers the UV transmittance, ultimately lowering the applied dose of a system. The quartz sleeves are easily cleaned by hand with a rag once or twice a year. Again, check with the manufacturer for recommended cleaning and maintenance intervals.

While there is no magic bullet that will solve every problem in an aquatic application, the addition of UV will certainly eliminate quite a few. Do your homework, and make sure the manufacturers do theirs. This will all be second nature before you know it. **I**

Dan Dycha is the National/International Swim-Fountain account manager/architectural design account manager for Emperor Aquatics Inc. He has been in the UV industry for more than four years, has hosted seminars at WWA and the Atlantic City Pool and Spa show for NESPA, and worked directly on the UV specification, validation and installation for the UV system at Seneca Lake for the State of New York Parks Department.

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