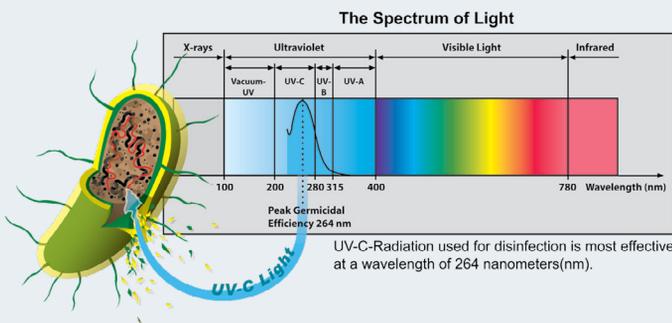


TECH TALK 135

How does UV Sterilize the Organisms in my water?

When you hear "UV", tanning on the beach may come to mind, but the UV light that water treatment systems emit is not the same UV that turns your skin to that golden brown, or red! Light is divided into wavelengths; for example red light and blue light are emitted at different wavelengths. Similarly there are 3 principal bands or wavelengths of UV that are of interest here. The three bands are called UV-A (long wavelength), UV-B, (mid wavelength) and UV-C (short wavelength). Sunlight that reaches the surface of the earth is comprised primarily of UV-A and has some UV-B. These wavelengths are what reach your skin when you go outside on a sunny day. UV-C is emitted by our sun, but is blocked by our atmosphere. UV-C is very natural!

UV-C is emitted at a wavelength range of 200nm (or nanometers) to 280nm.



Light emitted in the UV-C range is very effective at sterilizing very small organisms such as bacteria, fungi, algae, spores, viruses, etc. UV-B and UV-A do as well, just with much lower effectiveness. The peak effective wavelength for micro-organism sterilization is right near the middle of the UV-C wavelength band and found at 262nm. Keep that number in mind! That is where the biology and lamps meet; UV lamps primarily emit UV-C light at 254nm. This wavelength, which happens to be very close to the peak effective sterilization wavelength of 262nm!

It should be also noted that different organisms require different levels of exposure to UV-C in order to be sterilized; some organisms are tougher than others! This level of exposure is called UV "dose". In basic terms dose is the intensity of the emitted UV light multiplied by the exposure time. For example when using the same UV treatment system for an application, doubling the flow rate through the reactor would halve the dose value. A doubled flow rate means that the water was exposed to the light from the UV lamp for half the time it had been before.

Harmful Pathogens associated with Aquaculture

ALGAE	UV DOSE
Chlorella Vulgaris	22 mJ/cm2
BACTERIA	
Aeromonas salmonicida	3.6 mJ/cm2 (log-3)
Pseudomonas fluorescens (fin rot)	11 mJ/cm2 (log-3)
PROTOZOA	
Myxobolus cerebralis (TAMs, Whirling Disease)	40 mJ/cm2
Ichthyophthirius multifiliis (freshwater white spot)	100 mJ/cm2
Cryptocaryon irritans (marine white spot)	280 mJ/cm2
VIRUS	
KHV (Koi herpesvirus)	4 mJ/cm2
IHNV (Infectious Hematopoietic Necrosis/RTTO)	30 mJ/cm2
VHS (Viral Hemorrhagic Septicemia)	32 mJ/cm2
IPNV (Infectious Pancreatic Necrosis Virus)	246 mJ/cm2

So, How Does a UV System Work?

The lamps used for disinfection are very similar to the lamps used in the fluorescent fixtures in your home. The primary difference is that the lamps in your home convert ALL of the UV-C generated by the lamp into visible light. The UV lamps in your water treatment system have no visible light converting phosphor (that white stuff on the inside of the fluorescent lamps), and special quartz envelopes that allow the UV-C to transmit outside of the bulb. The lamps in your home use a special glass envelope that totally blocks UV at any wavelength be it UV-A, UV-B, or UV-C.

UV treatment systems are comprised of a highly efficient UV lamp that is situated within a high quality UV-C transmitting quartz sleeve, and in turn that lamp and sleeve are placed within a flow chamber or vessel. The quartz sleeve is the boundary between the water and the lamp; we don't want our lamps to get wet!

Water flows through the chamber, and around the lamp/sleeve assembly. The UV-C generated by the lamp emits through the water, hits the organisms we want sterilized, and does its job.

So, What Do We Need to Know to Ensure Successful Installation of a UV Treatment System?

- Target organism – What dose do we need?
- Flow Rate – so we can get you the right dose at your flow rate
- UVT or Ultra Violet Water Transmittance –What is that???

UVT or Ultra Violet Transmittance

Water as a fluid allows light to pass through it, we all know that. We also know that water "attenuates" or absorbs light as you go deeper and deeper into it, i.e. a lake or an ocean. Many people that scuba dive know that water absorbs red light faster than blue light; when you dive down the reds disappear or get absorbed before the blue light does. What this demonstrates is that water absorbs light at different rates, dependent on the wavelengths.

UVT is not a common term, in fact many do not even know that this parameter is one of the most important aspects with regards to ensuring that a UV treatment system works well. UVT is the amount of light, ONLY at 254nm (or the wavelength that the lamp emits) that can go through 1cm, or about 2/5's of an inch of water. For example a UVT of say 90% means that 90% of the UV-C light will still be there, and not absorbed, after travelling through 1cm of water. The lower the UVT, the more the UV-C light is absorbed by the water, and generally that means that we have to pick a system with more lamp power. Ineffective UV treatment can be attributed to improper consideration of UVT when sizing a system.

Now UV-C light gets absorbed very quickly by water, even in very pure water. Even our atmosphere absorbs it. If you add things to the water, i.e. anything, the amount of UV-C that gets absorbed goes even higher and effectively the UVT value drops. At microscopic levels minerals, chemicals, tannins, biological debris, etc., can reduce the UVT value of your water. Some typical UVT values are:

- Pools: 85% to 95% UVT
- Aquaculture: 70% to 98%
- Public aquariums & zoo displays: 70% to 98%.

As the water UVT drops, UV systems need more lamp power to reach the same target dose!

Did you know that a system for 90% UVT water can sometimes require as much as 20% to 30% more lamp power than that of a system for water with a 95% UVT, even though they have the same flow rates and dose level requirements? UVT is very important! If you were to use 95% UVT as your criteria when you purchased your system, and your water was actually 90% UVT, your system would not treat your water appropriately; it would be undersized, and perhaps drastically undersized! This is a reason many people have trouble getting UV to work for them. They don't take the actual UVT of their water into account. If you need assistance calculating your UVT please do not hesitate to contact a Pentair Aquatic Eco-Systems representative today!