The Science Behind UV Aquarium Sterilizers

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Used in concert with mechanical and biological filtration systems, UV sterilizers offer an effective defense against waterborne pathogens and free-floating algae. Unlike chemical remedies, they pose little risk to inhabitants, work around the clock, and leave no lingering harmful residues. But just how do these hi-tech helpers - which have been around for nearly three decades - use light to sterilize water?

What is ultraviolet light?

A: Ultraviolet (UV) light is the spectrum of energy below blue in the visible color range. Invisible to the human eye, UV exposure can cause sunburn, make a black light poster glow, and even kill germs, depending on the wavelength.

→ When light becomes lethal

While the UV spectrum ranges in wavelengths, the optimum wavelength for sterilization is between 200-280 nanometers. This spectral band is known as UV-C light, or the "germicidal wavelength," because it most effectively kills waterborne algae and microorganisms. At a peak lethal efficiency of 254nm, UV-C light irradiates free floating algae and pathogens at a cellular level, mutating DNA and disrupting an organism's ability to reproduce.

→ How do UV sterilizers work?

A UV sterilizer utilizes a germicidal fluorescent lamp that produces light at a wavelength of approximately 254 nanometers. As water with the bacteria/algae passes over the bulb (or around the bulb if a quartz sleeve is used) it is irradiated with this germicidal light. The required "killing dose" of UV light varies depending on the organism. The larger or more complex the organism, the greater the UV dose needed for effective sterilization.

Set at different flow rates, a UV sterilizer can be used effectively against bacteria, algae, or parasites. Different flow rates control different organisms. Therefore, a flow rate suitable for controlling bacteria or free-floating algae may not be effective against parasites. Larger organisms like parasites are more resistant to irradiation and require a slower flow rate to extend UV exposure time. To adjust UV

KILLING DOSE OF UV LIGHT NEEDED
(MICROWATT SECONDS PER SQUARE CENTIMETER)

viruses	15,000
bacteria	15,000-30,000
algae	22,000-30,000
fungi	45,000
protozoa	90,000

NOTE: These are generalities; some specific organisms in

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exposure time, simply increase or reduce the rate that water is flowing through the UV sterilizer.

these groups may require more or less of a dose than indicated.

→ Factors that determine killing power

The longer the amount of time the water is being exposed to the UV light, the more killing power is available. UV contact time, also referred to as "dwell time," is influenced by flow rate of the water - slower flow rates increase UV contact time. Bulb length also affects contact time. For example, with a longer bulb, the water is exposed to the UV light for a longer period of time. Some advancement in UV sterilizer design incorporates spiral or switchback chambers to increase dwell time, nearly tripling efficiency compared to similar sized units.

→ Additional factors to consider

BULB AGE As your UV bulb gets older, it may decrease efficiency by as much as 40%. Therefore, it is important to adjust your flow rate accordingly and replace bulbs every 8,000 -12,000 hours, depending on manufacturer recommendations.

WATER CLARITY A UV sterilizer's effectiveness is directly related to how green or "contaminated" the water is passing through it. The more turbid the water, the less the UV rays can penetrate lethally, reducing the overall effectiveness of the unit. If your water is particularly cloudy, you'll need to reduce your flow rate until the water clears again.

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