

## UV Basics

UV or ultraviolet lights emit most or all their light in the ultraviolet spectrum, which has higher frequency than the visible spectrum of light. There are some true UV lights, lights which don't emit any visible light, but they are less common than the so-called "black lights" which shine both purple and ultraviolet light. These lights can be used to make anything fluorescent glow, which makes them popular at parties.

## Fluorescent UV Lights

The most efficient UV lights are actually ordinary fluorescent tubes without the fluorescent coating. These long tubes are filled with argon and mercury gas with electrodes on either end. A high-voltage electric current runs through the gas between the electrodes. When one of the electrons from that current strikes a mercury molecule, part of its energy is absorbed, exciting the mercury. The mercury then shoots out the energy as a photon of ultraviolet or purple light. Normal fluorescent tubes have a coating which catches these photons and emits white lights, but UV tubes simply omit the coating.



## **How does UV work?**

Ultraviolet or UV energy is found in the electromagnetic spectrum between visible light and x-rays and can best be described as invisible radiation. In order to kill microorganisms, the UV rays must actually strike the cell. UV energy penetrates the outer cell membrane, passes through the cell body and disrupts its DNA preventing reproduction. UV treatment does not alter water chemically; nothing is being added except energy. The sterilized microorganisms are not removed from the water. UV disinfection does not remove dissolved organics, inorganics or particles in the water.

The degree of inactivation by ultraviolet radiation is directly related to the UV dose applied to the water. The dosage, a product of UV light intensity and exposure time, is measured in microwatt second per square centimeter ( $\mu\text{w}/\text{cm}^2$ ). The accompanying table lists dosage requirements to destroy common microorganisms. Most UV units are designed to provide a dosage greater than 30,000  $\mu\text{w}/\text{cm}^2$  after one year of continuous operation. Notice that UV does not effectively disinfect some organisms (most molds, protozoa, and cysts of *Giardia lamblia* and *Cryptosporidium*) since they require a higher dose.

## **UV units for water treatment**

Special low-pressure mercury vapor lamps produce ultraviolet radiation at 254 nm, the optimal wavelength for disinfection and ozone destruction. The UV lamp never contacts the water; it is either housed in a quartz glass sleeve inside the water chamber or mounted external to the water which flows through UV transparent Teflon tubes. Some ultrapure water systems use 185 nm UV units for reducing TOC (total organic carbon).