UV DISINFECTION INFO

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The info below was taken from this website: http://c.ymcdn.com/sites/www.isawwa.org/resource/resmgr/watercon2012-wednesday-pdf/wedtreatpot730.pdf.

WHAT DOES UV DO IN WATER?

• Disinfection of microorganisms – photons absorbed by DNA leads to inactivation (inability to replicate) by dimerization of thymine base units in the DNA • Photolysis – photons of UV light absorbed by molecules such as NDMA or hydrogen peroxide lead to chemical change, resulting in their destruction.

• UV is a known disinfection process • Different types of UV lamps are available • Certain parameters must be provided to manufacturers to accurately size a system • DW systems must be validated by a 3rd party • UV systems will require maintenance and monitoring • UV can be used in advanced oxidation applications (taste and odor, PPCPs, etc.)

The info below was taken from this website: https://www.water-research.net/index.php/water-treatment/water-disinfection/uv-disinfection

As a water treatment technique, UV is known to be an effective disinfectant due to its strong germicidal (inactivating) ability. UV disinfects water containing bacteria and viruses and can be effective against protozoans like, Giardia lamblia cysts or Cryptosporidium oocysts. UV has been used commercially for many years in the pharmaceutical, cosmetic, beverage, and electronics industries, especially in Europe. In the US, it was used for drinking water disinfection in the early 1900s but was abandoned due to high operating costs, unreliable equipment, and the expanding popularity of disinfection by chlorination.

Because of safety issues associated with the reliance of chlorination and improvement in the UV technology, UV has experienced increased acceptance in both municipal and household systems. There are few large-scale UV water treatment plants in the United States although there are more than 2,000 such plants in Europe. There are two classes of disinfection systems certified and classified by the NSF under Standard 55 – Class A and Class B Units.

Class A —These ultraviolet water treatment systems must have an 'intensity & saturation' rating of at least 40,000 uwsec/cm2 and possess designs that will allow them to disinfect and/or remove microorganisms from contaminated water. Affected contaminants should include bacteria and viruses

"Class A point-of-entry and point-of-use systems covered by this standard are designed to inactivate and/or remove microorganisms, including bacteria, viruses, Cryptosporidium oocyst and Giardia cysts, from contaminated water. Systems covered by this standard are not intended for the treatment of water that has obvious contamination or intentional source such as raw sewage, nor are systems intended to convert wastewater to drinking water. The systems are intended to be installed on visually clear water."

Class B — These ultraviolet water treatment systems must have an 'intensity & saturation' rating of at least 16,000 uw-sec/cm2 and possess designs that will allow them to provide supplemental bactericidal treatment of water already deemed 'safe'. i.e., no elevated levels of E. coli. or a standard plate count of less than 500 colonies per 1 ml. NSF Standard 55 "Class B" UV systems are designed to operate at a minimum dosage and are intended to "reduce normally occurring non-pathogenic or nuisance microorganisms only." The "Class B" or similar non-rated UV systems are not intended for the disinfection of "microbiologically unsafe water."

Therefore, the type of unit depends on your situation, source of water, and your water quality. Transmitted UV light dosage is affected by water clarity. Water treatment devices are dependent on the quality of the raw water. When turbidity is 5 NTU or greater and/or total suspended solids are greater than 10 ppm, pre-filtration of the water is highly recommended. Normally, it is advisable to install a 5 to 20 micron filter prior to a UV disinfection system.

UV RADIATION (HOW IT WORKS)

UV radiation affects microorganisms by altering the DNA in the cells and impeding reproduction. UV treatment does not remove organisms from the water, it merely inactivates them. The effectiveness of this process is related to exposure time and lamp intensity as well as general water quality parameters. The exposure time is reported as "microwatt-seconds per square centimeter" (µwatt-sec/cm^2), and the U.S. Department of Health and Human Services has established a minimum exposure of 16,000 µwatt-sec/cm^2 for UV disinfection systems. Most manufacturers provide a lamp intensity of 30,000-50,000µwatt-sec/cm^2. In general, coliform bacteria, for example, are destroyed at 7,000 µwatt-sec/cm^2. Since lamp intensity decreases over time with use, lamp replacement and proper pretreatment are key to the success of UV disinfection. In addition, UV systems should be equipped with a warning device to alert the owner when lamp intensity falls below the germicidal range. ▶▶▶

The following gives the irradiation time required to inactivate completely various microorganisms under 30,000 µwatt-sec/cm^2 dose of UV 254 nm

Used alone, UV radiation does not improve the taste, odor, or clarity of water. UV light is a very effective disinfectant, although the disinfection can only occur inside the unit. There is no residual disinfection in the water to inactivate bacteria that may survive or may be introduced after the water passes by the light source. The percentage of microorganisms destroyed depends on the intensity of the UV light, the contact time, raw water quality, and proper maintenance of the equipment. If material builds up on the glass sleeve or the particle load is high, the light intensity and the effectiveness of treatment are reduced. At sufficiently high doses, all waterborne enteric pathogens are inactivated by UV radiation. The general order of microbial resistance (from least to most) and corresponding UV doses for extensive (>99.9%) inactivation are: vegetative bacteria and the protozoan parasites Cryptosporidium parvum and Giardia lamblia at low doses (1-10 mJ/cm2) and enteric viruses and bacterial spores at high doses (30-150 mJ/cm2). Most low-pressure mercury lamp UV disinfection systems can readily achieve UV radiation doses of 50-150 mJ/cm2 in high quality water, and therefore efficiently disinfect essentially all waterborne pathogens. However, dissolved organic matter, such as natural organic matter, certain inorganic solutes, such as iron, sulfites and nitrites, and suspended matter (particulates or turbidity) will absorb UV radiation or shield microbes from UV radiation, resulting in lower delivered UV doses and reduced microbial disinfection. Another concern about disinfecting microbes with lower doses of UV radiation is the ability of bacteria and other cellular microbes to repair UV-induced damage and restore infectivity, a phenomenon known as reactivation.

This was just a short introduction to UV Disinfection information. Further research can and should be done before making the switch to this method of disinfection. You can go to the web-sites I used or choose from the seemingly unlimited number of others available. 💧💧💧