Aquafacts No.18

Ultraviolet water treatment systems

Ultraviolet (UV) radiation technology has become an established method of disinfecting water, Its versatility enables UV to be used on a large scale within a municipal treatment plant and on individual water applications as varied as food processing and cosmetic production. It can also be used in the home where water is sourced from a private well or bore hole. (It is not a treatment that will benefit domestic customers on an ordinary mains water supply).

Since the introduction of the Private Water Supplies Regulations back in 1991, interest in UV has grown, particularly as its major function is health related. UV offers a rapid and simple technique to rid water of bacteria, algae, mould, fungi and virus contamination including pathogenic organisms, without using heat or chemicals.

What is Ultraviolet Radiation

One of the several categories of energy is electromagnetic or radiant energy. Solar radiant energy travels in the form of waves in straight lines in all directions from the sun. There are very long waves and very short X-rays. We are all aware of the visible part of the spectrum. The ultraviolet part includes wavelengths from 2000 to 3900 Angstrom units (one unit is equivalent to one ten billionth of a meter). There are long waves, middle waves (best known for their sun tanning effects) and short waves. It is this latter segment which is so effective in destroying bacteria.

Short wave ultraviolet does not occur naturally as the atmosphere screens out the sunlight UV before it reaches the earth's surface. To take advantage of the germ killing potential of short wave ultraviolet the rays must be created artificially. This is achieved by using a mercury vapour lamp which converts electrical energy into UV radiant energy at around 2540 Angstroms.

UV Equipment

A typical ultraviolet water treatment system provides high intensity UV light rays which eradicates the water as it passes through an illuminated chamber. The gemicidal (mercury vapour) lamp creates an electric arc through an inert gas within a special glass tube. The heat created causes a vapourisation of a small amount of mercury which ionises in the electric arc and gives off UV radiation. Most UV units are designed as a cylindrical module in stainless steel or plastic. The water flows in at one end and passes through the annular space between the quartz sleeve (which contains the lamp) and the outer wall of the chamber before exiting at the other end of the what is usually a cylindrical module.

There are many different types, styles and sizes of UV system dependent on the volume of water needing to be treated. Domestic models are quite small. The degree of disinfection relies on flow rate,quality of water, type of organism, concentration etc. The germicidal lamp, which is continuously illuminated, has a life expectancy of between six and twelve months and is designed to produce a UV dosage rate of between 20,000 and 40,000 microwatt-seconds per square meter. Most systems incorporate a pre-filter as cloudy water can impede the transmission of UV energy.

Performance, advantages and disadvantages of UV

UV can kill micro-organisms far quicker than chlorine (1/2 to 1 second, compared to 20 to 40 minutes). It also has the ability to destroy molecular bonds in micro-organisms by disrupting the RNA and DNA chains that control their ability to reproduce.

The main advantages of UV are:

1. Can treat large as well as small volumes of water quickly.
2. No danger of overdosing.
3. Water is ready for immediate use after treatment.
4. Provides continuous or intermittent disinfection auto-matically without special attention or measurement.
5. No after-taste or odour problems are created.
6. Equipment is compact as well as being straightforward to maintain.
7. No chemicals are involved.
8. Environmentally friendly.

There are few disadvantages. There is no residual effect with UV and it will not work with cloudy water. UV, like chlorine, has no effect on cryptosporidium or giardia. When not flowing the water around the lamp can become warm. Athough rare lamps can fail suddenly. This may not be noticed. Water then passes through the system untreated.

Conclusion

UV disinfection can be viewed as economical as well as cost effective. It is also safe as one of its major advantages is that nothing is added to the water. It will suit a variety of applications and can be installed without too much difficulty. This makes it a particularly attractive choice for treating domestic drinking water. It must be remembered however that UV is only an excellent 'bug zapper' and may need to be incorporated with filters, reverse osmosis and a softener as part of a total water treatment package.

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