Wastewater Re-use

Using UV Disinfection

berson masters in uv

The UV disinfection industry has experienced tremendous growth over the last 20 years – particularly in Europe, the USA, the Middle East and South East Asia. The development of new UV technologies over this period is a perfect example of an industry investing to meet market demand – in this case demand for an effective, low cost, and environmentally friendly way to disinfect wastewater for reuse.

The acceptance of UV disinfection at wastewater plants treating almost four billion litres daily is proof that UV is no longer an 'emerging' technology, but rather an accepted technology to be used routinely by engineers to safeguard human health and alleviate environmental pressures.

Wastewater reuse has been practiced in various forms for decades, with the USA leading the way in reuse research. It is now a major issue in the southern USA, southern Europe, the Middle East, Australia and many parts of Asia where chronic water shortages are driving investment in reuse technology.

New Technology

The use of computational fluid dynamics (CFD) modelling has vastly improved UV equipment manufacturers' ability to predict with confidence the level of treatment required for wastewater using their proprietary equipment. All manufacturers will soon use this tool to optimize the dose delivery of their reactors and minimize energy costs. Also, as manufacturers develop and improve optimized UV reactors, they will be able to validate the designs using recognised validation protocols.

Conventional UV lamp technology will also improve over the coming years, with medium pressure lamps continuing to see gains in energy efficiency, lamp life and power density, and Quartz coating techniques extending lamp life to well over 12,000 hours.

Concerns

A major concern to the UV industry is the issue of reactivation – the apparent ability of some microorganisms to repair the damage done to their DNA by UV, reactivating their ability to infect. DNA repair can occur in a closed (dark) system, but is more likely in open systems under direct sunlight (photoreactivation). The dose level and lamp type seem to affect the degree of reactivation, with low pressure (single wavelength) UV lamps appearing to be more susceptible to photoreactivation than medium pressure (multi-wavelength) lamps (see reference 1). A much larger research effort into the area of photoreactivation is required and will most likely be forthcoming over the next five years.

A significant amount of research has also targeted the question of UV disinfection by-products, specifically the most common water constituents such as chlorine, bromide, nitrate, ozone, natural organic matter and iron. At normal UV disinfection doses no significant disinfection by-products have been shown to form.

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Benefits of UV for the reuse market

The most common method of wastewater disinfection for reuse has long been chlorination. Despite chlorine's impressive track record, concerns regarding disinfection by-products (DBPs) and, more recently, disinfection performance with respect to pathogen inactivation, are driving the conversion from chlorine disinfection to other disinfection methods such as UV, which does not produce any DBPs.

Closed vessel UV systems are easy to install within existing pipework, so there is minimal disruption to plant operation. Day to day operation is simple and only minor maintenance is needed. The only regular requirement is changing the UV lamps and wiper rings once a year, a straightforward operation that can be carried out by on-site personnel.

UV systems for wastewater reuse are also validated to much higher doses than drinking water systems, according to protocols established by the National Water Research Institute (NWRI) in the USA. Drinking water type product validation, with the accompanying rigor, will emerge as the dominant method of assessing suitability for these critical applications. The ability to prevent photo repair will also emerge as key.

Applications for wastewater reuse

Potential applications for wastewater reuse are extremely wide-ranging and include any instance where water is needed for non-potable use. The most popular and widespread use is for agricultural irrigation, with California and Florida leading the way in the USA and a number of Australian states also making significant progress. Other irrigation uses include landscape and recreational applications such as golf courses, parks, and lawns.

Reclaimed wastewater is also used for groundwater recharge applications such as aquifer storage and recovery or preventing saltwater intrusion in coastal aquifers. Other uses include toilet and urinal flushing, fire fighting, foundation stabilization in the construction industry and artificial snow generation. In all these applications, reuse wastewater relieves the burden on existing municipal potable supplies

Case study

Arizona, USA

Two golf courses in Anthem, Arizona, are using UV-treated wastewater for irrigation. Founded less than 10 years ago Anthem, a town just north of Phoenix, now has a population of over 40,000. As part of its rapid expansion the town recently installed three-closed chamber, medium pressure UV system from Berson UV-techniek to disinfect its wastewater. This allows the town to not only meet increased demands in its water and wastewater treatment capacity, but also to exceed the output quality standards.

"The wastewater is treated by three Berson InLine systems handling a combined flow of three million gallons per day," explained Anthem's wastewater Foreman Jeff Marlow. "They work in conjunction with microfiltration and nitrification/denitrification. We chose the Berson UV systems because they are optimized to meet the upcoming Arizona Pollutant Discharge Elimination System (AZPDES) Permit Program," he added.

The two local golf courses currently use a combination of UV treated wastewater and fresh river water for irrigation, but with increase in population, it is expected that the courses will soon be using wastewater exclusively.

An automatic cleaning mechanism keeps the lamp sleeves free of organic deposits for consistent UV dosing. Each chamber is also fitted with UV monitors to measure actual UV dose for record keeping. With the addition of an optional online transmittance monitor, real time transmittance values are used to automatically adjust the dose pacing of the UV system.

Conclusion

The UV industry has matured considerably over the last decade and is now highly regulated and dominated by the world's major water technology companies. Conventional UV technologies have been field-tested and now have considerable track records in a wide range of applications. Uncertainties surrounding regulations, royalties, technology and engineering have decreased and acceptance of UV is expected to grow rapidly over the next 20 years. Conventional UV designs have been greatly aided by CFD, which will be used as a routine sizing tool for future designs.

The stage is now set for dramatic growth in the wastewater reuse market, especially with increasing populations putting even more pressure on already overstretched water resources in many regions of the world. Tighter limitations on pollution discharge will also play an important role in the development of this technology.

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