HTX

ADVANCED WATER TREATMENT

HYDRUS TECHNOLOGY

NON-CHEMICAL WASTEWATER DISINFECTION

1. Introduction & Background

The origins of the wastewater treatment sector lies in public health measures mandated by the outbreak of infectious diseases such as cholera and the bubonic plague. As a result of government intervention, the provision of drinking water and sewer services was for many years considered a 'free good', and accordingly ownership structures have reflected this structure. With increasing water scarcity, the supply of potable water has only recently emerged from this public ownership model.

Similar stories relating the history of public ownership of water and wastewater assets can be found globally, with major cities such as China's Shanghai having a population of over 20 million inhabitants - discharging untreated sewerage to river systems as recently as 1998. Untreated wastewater discharge has been credited with responsibility for serious pollution in 90% of Chinese cities and water sources in about 50% of key cities cannot meet standards for drinking water.

With the availability of public drinking water has come the demand for development of improved disinfection standards. In cases of wastewater treatment however, the very many alternative uses for water, such as crop irrigation and industrial processes, have required less stringent standards than for potable water.

Nevertheless, chlorination of both potable water and wastewater supplies has been universally embraced. Most public swimming pools for example, carry the familiar smell associated with chlorine and its closely related chemical by-products, the chloramines.

However, it is only in the last 10 years that chlorination of water has been linked to cancers in human and aquatic species, with several halogenated methanes (HMs), such as trihalogenated methane (THMs) found in chlorinated wastewater, now known human carcinogens.

2. Key Challenges

The traditional water and wastewater sector therefore faces the following significant challenges:

- Increased technical complexity due to greater prevalence of chemicals in both raw water and treated wastewater streams – such as both endocrine disrupting chemicals (EDCs) and trihalogenated methanes (THMs) - now recognized as known human carcinogens
- Long project lifecycles arising from the need to upgrade extensive networks of aging infrastructure
- Demand for major capital investment at a time when there are more projects than available capital within the public sector

- Operational budgets increasingly squeezed due to high energy costs for pumping and conventional wastewater aeration
- Talent crisis as many wastewater treatment specialists abandon the public ownership model to earn substantially more as either consultants or by working for the private sector.

3. Problem

The increasing use of products by society as diverse as shampoos, conditioners, contraceptive pills, mood stabilisers, antidepressants, biocidal antiseptics and recreational drugs such as methamphetamines – are emerging as untreated components of many wastewater streams. As many of these discharge into fresh and saltwater marine ecosystems, the wastewater sector is coming under increased scrutiny over its inability to remove these components from the treated wastewater stream.

In particular, the continued use of chlorine – in either gaseous or water soluble chemical forms such as hypochlorites - is meeting growing criticism as a result of the direct linkage to human cancers, and as a result of the formation of endocrine disrupting chemicals (EDCs) following wastewater disinfection by traditional means.

Endocrine disruptors are chemicals that, at certain doses, can interfere with the endocrine (or hormone system) in mammals. These disruptions can cause cancerous tumors, birth defects, and other developmental disorders. Specifically, endocrine disruptors have been linked to the development of learning disabilities, deformities, breast, prostate, thyroid and other cancers as well as sexual development problems across ecosystems such as feminizing of males or masculinizing effects on females, etc.

The disinfection by chlorination of wastewater effluents is expected to be banned by environmental regulators in most developed and developing countries within the next decade. The disinfection of drinking water is also expected to come under increasing pressure from both the public and regulatory agencies as a result of the known carcinogenic properties of THMs and EDCs. Accordingly, there is an urgent requirement to find and commercially develop alternative water disinfection systems.

4. Solution

Hydrus Technology has developed technologies for licensing to the private sector, which focus on three key aspects of the water and wastewater disinfection cycle:

- Extraction of ammonia to avoid production of halogenated methanes (HMs) which have ammonia as a pre-cursor
- Cell disruption of all water borne coliform organisms, bacteria, protozoa and viruses by

electrochemical and electrolytic means, in place of chemical disinfection by chlorine gas or chlorine chemicals

- The development of Enhanced and Catalysed Oxidation Processes (EOP / COP) for wastewater treatment wherein identified ***refractory*** organic compounds, such as endocrine disruptive chemicals, can be destroyed
- The development of tailored *adsorptive magnetic minerals* to enable removal of residual identified precursor chemicals, in wastewater treatment.

While both gaseous ozone and Ultraviolet (UV) light can perform a water disinfection role, regulatory agencies are concerned that they provide no residual benefit, since a microscopic organism can escape cellular disruption shielding behind suspended particulates many times their size. Electrolysis of water has better acceptance by regulators since it not only impacts any waterborne organism but also because most cellular membranes operate electrochemically, and thus cannot survive imposed current densities several thousand times higher than their operating densities.

5. Conclusion

The development of alternative disinfection systems to conventional chlorination of water and wastewater is imperative and is likely to be increasingly demanded of regulatory agencies by an increasingly concerned community.

Of the available disinfection systems, gaseous ozone and ultraviolet light are the only non-chlorine systems available, and both suffer disadvantages when compared to chlorine.

Whereas chlorine disrupts or perforates the cellular wall of single celled organisms, only ozone or electrochemical treatment perform this function effectively in wastewater systems. However, ozone has no residual benefit since it breaks down to oxygen rapidly in water and wastewater systems.

Electrochemical water disinfection systems offer many benefits compared to chlorine, ozone and UV light:

- Total disruption of the cellular wall of most problem micro-organisms by a process equivalent at human scale - to a high voltage electric shock
- Non-specificity: equally affective for coliforms, bacteria, protozoa and viruses
- Low cost compared to high intensity UV disinfection
- No chloramine by-product formation
- Destruction of EDCs and other trace organics when used in conjunction with enhanced oxidation processes

- Not susceptible to turbidity: a major disadvantage of UV based disinfection systems
- Small footprint and ease of retrofit.