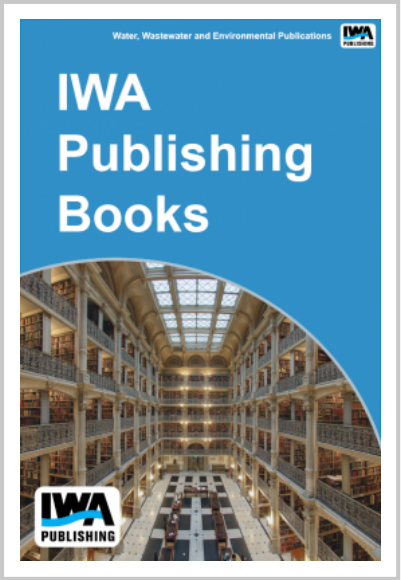
Fate and Persistence of Pathogens Subjected to Disinfection



Disinfection of wastewater is a necessary treatment process for protecting the public from potential exposure to pathogenic microorganisms. Two common forms of disinfection are chlorine and ultraviolet (UV) light. However, microorganisms differ in their susceptibility to UV and chlorine disinfectants. It is necessary to understand how different classes of pathogens respond to UV and chlorine disinfection processes in wastewater to better develop strategies for optimizing the treatment of pathogens in wastewater. It is also recognized that water quality may impact disinfection effectiveness, such as protection of pathogen by particles and disinfectant demand.

This study investigated bacteria, viruses and protozoan pathogens. All species of bacteria tested were susceptible to both UV and chlorine, despite differences in antibiotic resistance and tendency to aggregate. Upon exposure to disinfection conditions that could indicate viability of the bacteria tested, but not culturability using common methods, it was found that UV and chlorine were effective in eliminating the capability of viable but non-culturable bacteria to resuscitate. Clostridium spores were resistant to free chlorine and UV disinfection but found to be susceptible to long exposure to monochloramine. Cryptosporidium was resistant to all chlorine forms but very susceptible to UV irradiation. Pathogenic and indicator viruses tested were very susceptible to free chlorine and UV disinfection. UV radiation throughout the 200 to 300 nm range was effective for inactivation of viruses and C. parvum, but wavelengths between 260-270 nm and below 220 nm appeared to be more effective for viruses, suggesting a possible advantage for polychromatic UV sources.

Sequential disinfection strategies were proposed and tested to enhance inactivation of various microorganisms. One scenario integrated UV disinfection followed by dynamic chloramination through addition of free chlorine and subsequent transformation to combined chlorine. Further, disinfection of microorganisms in wastewater presents challenges that are inherent to the water matrix, such as pathogens associated with particles. UV and chlorine were both effective for disinfection of coliform in wastewater but chlorine was found to be more effective during long contact times for inactivation of particle associated coliform. In addition to coliform, both Cryptosporidium parvum and Salmonella typhimurium were identified as being particle associated in wastewater using molecular approaches developed to detect microbes in environmental samples

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