Evaluating Acidic Disinfection

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Peracetic acid gaining ground as effective disinfection alternative


PAA residual test kit


PAA pilot study

With uncertainty regarding requirements for future use of chlorine gas due to safety concerns and challenges associated with chlorinated disinfection byproducts (DBPs) for gaseous or liquid chlorine, wastewater facilities are proactively looking for options to replace chlorination with disinfection alternatives. The increased interest in alternatives has pushed technology and efficiency advances in mature as well as in innovative technologies that have been historically used in other industries. While the advances in ultraviolet (UV) and ozone disinfection make the technology more energy efficient, there sometimes are challenges, including high capital costs and consistent disinfection performance for facilities with high peaking factors or difficult effluent quality (e.g., low UV transmittance or high ozone demands).

Peracetic Acid Chemistry

Peracetic acid (PAA), a chemical oxidant that has been applied to the food, beverage, medical and pharmaceutical industries as a disinfectant for many years, is a wastewater disinfection alternative that is gaining attention due to its ability to provide bacterial inactivation performance competitive with other mature technologies. PAA has the chemical formula CH_3CO_3H and is delivered as a solution in which it is in equilibrium with hydrogen peroxide, acetic acid and water.

PAA solutions generally are prepared by reacting acetic acid with hydrogen peroxide in the presence of a catalyst; a range of PAA concentrations is formulated by adjusting the concentrations of reagents during the manufacturing process.

Compared with other chemical oxidants used in water and wastewater treatment, PAA has a relatively high oxidation potential that makes it attractive for disinfection. It is effective against a range of microorganisms and is most effective at pH values below the logarithmic value of its acid dissociation constant, or pKa (8.2), but has high efficacy up to a pH of about 9. PAA also is effective at low temperatures (5˚C) and is relatively unaffected by effluent organic matter compared with other chemical oxidants used for disinfection (e.g., chlorine or ozone). Additionally, PAA has a long shelf life as a result of proprietary stabilizers that can be used in commercial solutions, an advantage over liquid chlorine.

Treatment Applications

The U.S. Environmental Protection Agency (EPA) has approved PAA in specific formulations for use as a disinfectant to treat wastewater. As noted, PAA has proven effective over a wide range of effluent qualities, requiring low doses of chemical to achieve bacterial inactivation. The capital costs for retrofitting of existing chlorine facilities is low when existing chlorine contact basins can be utilized. In addition to potential capital cost savings by avoiding retrofitting, PAA is able to provide treatment for challenging effluent, while meeting stringent limits for trihalomethanes and other regulated and unregulated DBP compounds. One of the most interesting benefits of PAA is the operational ease that comes from the ability to feed a relatively consistent dose to provide disinfection, even when wastewater effluent quality changes, particularly with respect to ammonia concentrations that can fluctuate widely when facilities switch between nitrification modes when only seasonal nitrification is required.

While PAA has a long list of benefits, its use for wastewater disinfection in the U.S. is still limited when compared to other more mature technologies such as chlorination, ozone and UV. PAA is commonly used as a substitute for sodium hypochlorite in Europe, where DBPs are a key driver for its use. There is a full-scale application in St. Augustine, Fla., which is permitted to use this technology for year-round disinfection. The application was implemented as an alternative to UV or ozone to address compliance issues with DBP formation. Another municipal facility in Frankfort, Ky., uses PAA as a full-scale back-up to its ozone disinfection system. There also are a number of ongoing pilot studies that are evaluating the roles of site-specific factors to identify dosing requirements for various systems. While for secondary effluent initial design dosing typically is around 2 mg/L of PAA, dose is site specific, and testing should be conducted to evaluate PAA use as a disinfection alternative.

Site-Specific Evaluation

The disinfection efficacy of PAA can be tested in an onsite laboratory using a jar tester and a fresh, undisinfected effluent sample. The procedure includes measuring the sample into jars and adding varying volumes of neat (as-delivered) PAA to each stirred jar to achieve a range of test doses. PAA should not be diluted for dosing because the solution equilibrium can be changed; it is important to use a micropipette capable of measuring very small volumes (10 to 100 µL) for neat dosing, as PAA is delivered from the manufacturer in solution concentrations of approximately 15%.

During the test, one jar is left untreated as a control and, after addition of PAA to the test jars, samples are collected at a target contact time. For chlorine retrofit applications, samples are generally collected at either 15 or 30 minutes, depending on the contact time of the existing system; however, there is ongoing testing at some facilities for shorter contact times. Samples are collected for target microbe testing (for example, *E. coli* or fecal coliform) and other parameters which might include PAA residual, total suspended solids and DBPs.

For microbiological analyses, PAA is neutralized by using sodium thiosulfate in the sample bottle, exactly as a sample would be preserved following chlorination. The results of treated samples at various PAA doses are compared with untreated controls and the permit limits to estimate a required dose. It also is useful to conduct sampling against the incumbent technology in order for a comparison to be made; this is particularly important for DBP formation potential evaluations.

PAA is an alternative with great potential in the wastewater marketplace, and it has recently gained a great deal of interest due to its ability to provide bacterial inactivation at life-cycle costs competitive

Disinfected samples are tested against controls. Both negative controls and untreated samples are shown for *E. coli*, measured by Colisure in a recent pilot study.

to mature technologies. In addition to cost savings, the ability to provide treatment for challenging effluent while meeting stringent DBP limits is driving evaluation of PAA. While PAA is becoming more widely recognized, it is critical to conduct site-specific evaluations—both laboratory and pilot-scale—to obtain engineering design criteria and demonstration data to help decision-makers understand and obtain local regulatory support for implementation of PAA disinfection projects. WWD

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