Guidance WQD-003
August 2017

GUIDANCE

Peracetic Acid
as a Disinfectant for Wastewater

This guidance document is intended to provide general design criteria since the Oklahoma Department of Environmental Quality (DEQ) has no official regulations in place for the design and construction of a peracetic acid system to be used as disinfection for wastewater. The DEQ has a Variance Committee (OAC:656-3-7) to review processes or equipment not specifically covered by the standards in Chapter 656 provided the permittee requests a variance.

Disclaimer

The premise of this Guidance manual is that the technology/approach discussed in the following is that Engineering Design requirements have not been established. The approach/guidance provided offers suggestions that Utilities may consider and discuss with ODEQ before embarking on the use of this technology. It is anticipated that over time this guidance would be eliminated and design requirements will be established in OAC 252:656

Definitions

Peracetic Acid – (PAA), a strong oxidizing agent used for disinfection. PAA is commercially available as a solution primarily comprised of peracetic acid, acetic acid, water, and hydrogen peroxide.

Abbreviations

DEQ – Department of Environmental Quality
PAA – Peracetic Acid

Applicable OAC Sections

OAC 252:626-11
OAC 252:656-17

Background

Peracetic Acid. Peracetic acid (PAA) is a strong oxidizing agent used for disinfection. PAA is commercially available as a solution primarily comprised of peracetic acid, acetic acid, water, and hydrogen peroxide. It is generally believed that the bacteria are destroyed as a result of cell lysis and that PAA damages the nucleic acids and/or surface structure of phages. Effectiveness as a disinfectant depends on the susceptibility of the target organisms, the contact time, and the concentration of the PAA. PAA is an alternative to chlorine-based products. Test results show that PAA is a fast-acting disinfectant with initial fecal coliform counts reduced 10-fold within the first 8-10 minutes with a 5.0 ppm dose rate; however, PAA disinfection efficacy varies on a site-to-site basis based on specific bacterial population and other water quality parameters such as chemical oxygen demand and color.

Peracetic acid is an equilibrium mixture of acetic acid, hydrogen peroxide, and water:

$$\underset{\text{Acetic Acid}}{CH_3COOH} + \underset{\text{Hydrogen peroxide}}{H_2O_2} \leftrightarrow \underset{\text{Peracetic Acid}}{CH_3COOOH} + H_2O$$

Most systems in the United States receive PAA in containers not larger than 300-gallon one-way disposable totes; however, use of bulk chemical storage is possible for appropriate applications.

Guidance Study Requirements

Sufficient data needs to be provided that will allow the DEQ Water Quality Division Variance Committee to understand and approve the implantation of the guidance described in this document. A meeting with DEQ should be scheduled by the Utility to discuss the various approaches:

(A) Consider results from approved design literature.
(B) Summarize information from literature.
(C) Provide demonstration data from other locations.
(D) Perform a pilot study to determine design parameters through testing and evaluations made under the supervision of a competent process engineer, licensed in the State of Oklahoma. Submit the pilot study protocol to the DEQ for review and approval before performing the pilot study. PAA pilot studies should include analysis of TOC before and after treatment to determine the potential effects to the BOD or CBOD effluent limits.
(E) Submit a final pilot study report documenting the results of the testing along with the design doses and contact time to be used for implementation full-scale. This document should also address water quality observed during the pilot study and how it compares to historic water quality parameters that may impact the final design. The report should also consider effluent toxicity issues arising from residual PAA and how this toxicity can best be abated.

Guidance Design Requirements

(A) Provide recommendations and conceptual design information.
(B) Provide hydraulic loading requirements and projected water quality.
(C) For disinfection, provide adequate capacity to produce an effluent that will meet the applicable bacterial limits defined in the OPDES discharge permit.
(D) Provide a minimum PAA dose that results in a PAA residual of 1.0 ppm or the documented design dose determined through the pilot study, whichever is greater. Required disinfection capacity will vary, depending on the uses and points of PAA application.

(E) Design the system on a rational basis using calculations to justify the equipment sizing and number of units for the whole operating range of flow rates. Provide a description of how the process will be controlled. Identify any residual instrumentation.

(F) Satisfy the following requirements related to PAA storage containers:
   1. Provide storage containers of sturdy, non-corrosive material with secure tops to contain PAA.
   2. Keep chemicals used in PAA disinfection upright, in their original shipping containers with hazard labels intact. Stacking of PAA chemical containers is prohibited.
   3. Provide bulk on-site storage with pressure relief and overflow piping. Prevent venting of the overflow piping to the indoors by using a water seal or other device.
   4. Provide space for at least thirty (30) days' supply of PAA.
   5. Follow requirements for secondary containment at OAC 252:626-11-(3)(g)(4)(B) and OAC 252:626-11-(3)(h)(11).

(G) Satisfy the following requirements related to PAA housing:
   1. Verify a complete local Code review has been conducted, referencing the applicable building, electrical, and fire codes to determine storage and feed requirements as part of the ER.
   2. Store on an acid-proof floor in an area separate from all other processes. Keep separate from other acids, oxidizing agents, strong reducing agents, alkalis, organic materials, heavy metals, and flammable substances.
   3. Avoid temperatures above 86° F (30° C) and below 40° F (4° C) unless data from the vendors can be provided showing that temperature ranges can be modified.

(H) Locate leak detection equipment near chemicals and near valves and equipment that pose a potential threat.

(I) Use manufacturer-approved compatible piping and connections. Use PAA piping that is color-coded and labeled to distinguish it from other plant piping.

(J) Mix the disinfectant as rapidly as possible, with a complete mix being affected in three (3) seconds. This may be accomplished by either the use of turbulent flow regime, computational fluid dynamic modeling, in addition to the data collected from the pilot study, may be used to demonstrate complete mixing utilizing an alternate mixing method.

(K) Satisfy the following requirements related to contact period and contact tanks:
   1. Provide a minimum contact period of ten (10) minutes at design peak hourly flow or maximum rate of flow after thorough mixing. Evaluate existing contact tanks by conducting field tracer studies (following a protocol approved by DEQ) to assure adequate contact time.
   2. Construct contact tanks to reduce short-circuiting of flow to a practical minimum.
   3. Provide tanks that have continuous mixing with "over-and-under" or "end-around" baffling.
   4. Design tanks to facilitate maintenance and cleaning without reducing effectiveness of disinfection.

(L) Provide an alarm system for PAA unit as follows:

1. The alarm system must have no cross-connections.
2. The applicant must specify what the alarm requirements need to be in order to assure consistent disinfection in compliance with the applicable bacterial limits.

(M) Provide standby equipment of sufficient capacity to replace the largest unit during shutdowns. Provide spare parts for all disinfection equipment to replace parts which are subject to wear and breakage.

(N) Make readily available protective safety equipment to personnel, including goggles, protective clothing, gloves, and respirators. Provide respiratory air-pac protection equipment, meeting the requirements of National Institute of Safety and Health (NIOSH) to be stored at a convenient location, but not inside any room where PAA is used or stored. Post instructions for using the equipment. Air-pac units are to use compressed air, having at least a thirty (30)-minute capacity and must be compatible with the units used by the fire department responsible for the treatment facility.

(O) Provide a means for sampling effluent PAA concentration, including at least one (1) point downstream of the PAA contact tank, which may be the same as the point of compliance. Identify sampling points in the ER.

References

1. Antonelli, M., Mezzanotte, V., and Pannouilleres, M. 2009. Assessment of Peracetic Acid Disinfected Effluents by Microbiotests. Environmental Science & Technology, 43, pp: 6579-6584.
2. Baldry, M.G.C., French, M.S., and Slater, D. 1991. The Activity of Peracetic Acid on Sewage Indicator Bacteria and Viruses. Water Science Technology, 24 (2), pp: 353–357.
3. Dell'Erba, A., Falsanisi, D., Liberti, L., Notarnicola, M., and Santoro, D. 2007. Disinfection By-products Formation during Wastewater Disinfection with Peracetic Acid. Desalination, 215 pp: 177-186.
4. Kitis, M., 2004. Disinfection of Wastewater with Peracetic Acid: A Review. Environmental International, 30, pp: 47–55.
5. Alternative Disinfection Methods Fact Sheet, “Peracetic Acid,” EPA, September 2012.
6. Metcalf & Eddy. 2003. *Wastewater Engineering, Treatment and Reuse*. 4th ed. McGraw-Hill, New York.