Microbial Inactivation by Peracetic Acid in Sewage and Feces to Optimize Disinfection of Highly Infectious Waste Waters

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Introduction: Waters impacted by improperly treated or untreated human excreta, such as high risk human wastes and wastewaters discharged from hospitals, waters in close proximity to open defecation sites, or urban areas with combined sewerage can contain high levels of pathogens. Poor quality wastewaters, such as those contaminated by human feces, can contain high levels of suspended solids and organic loads that prevent on-site decontamination by traditional treatment technologies, such as chlorine dosing, by rapidly reducing disinfectant concentrations before target microbial reductions are achieved.

Objectives: Evaluate and quantify inactivation of *E. coli*, *S. typhimurium*, *R. terrigena*, *Clostridium sporogenes* spores, MS2 and ΦX174 coliphages, and *Cryptosporidium parvum* oocysts by Peracetic Acid (PAA) in hospital sewage and feces.

Methods: Evaluation of microbial reductions in pasteurized hospital sewage and a fecal matrix consisting of 33% feces in hospital sewage was performed in batch lab-scale experiments seeded with microorganisms. Seeded test waters were dosed with PAA concentrations ranging from 4 mg/L to 4000 mg/L and neutralized at time points up to 30 minutes. Influent and effluent *E. coli*, *S. typhimurium*, and *R. terrigena* were enumerated by spread plate method on Bio-Rad Rapid'*E. coli* 2 agar. *C. sporogenes* spores were assayed by spread plate method on reinforced clostridial medium and anaerobically incubated in jars. MS2 and ΦX174 coliphage were enumerated by DAL plaque assay method, EPA method 1602, with *E. coli* Famp and CN13 hosts, respectively. *C. parvum* infectivity was assayed for infectious focus-formation in HCT-8 mammalian cell cultures and enumerated by immunofluorescent microscopy.

Results: An Initial PAA dose of 4000 mg/L gave greater than 4 $\log_{10}$ (99.99%) inactivation by 10 minutes in the hospital sewage and the fecal matrix for *E. coli*, *S. typhimurium*, *R. terrigena*, *C sporogenes* spores, and ΦX174 coliphage; for MS2 coliphage and *C. parvum* greater than 2 $\log_{10}$ (99%) inactivation was achieved by 10 minutes. PAA concentration x contact time (CT) values of 2960 and 16,939 min*mg/L were reached at 10 minutes of exposure for 400 mg/L and 2000 mg/L initial PAA doses, respectively in hospital sewage. A CT value of 17,083 and 34,167 min*mg/L was reached at 10 minutes for 2000 mg/L and 4000 mg/L initial PAA dose respectively in the fecal matrix. This research demonstrates that rapid and effective disinfection of highly infectious hospital waste is achieved by mixing 1% PAA (15% stock PAA concentration) by volume directly into the toilet or other container.