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presentation title, authors, references, keywords, key takeaway # Introduction

The goal of this work is to reduce the cost of disinfection using peracetic acid (PAA) at the Robert W. Hite Treatment Facility operated by the Metro Wastewater Reclamation District (MWRD) in Denver, CO. Due to differences between the initial PAA pilot and full-scale disinfection installation (e.g., geometry and residence time of disinfection basin, variable influent E. coli concentrations, variable PAA initial demand), MWRD experienced an instance of exceeding its E. coli discharge limit for a single day (252 MPN/100 mL based on a 7-day geometric mean, 126 MPN/100 mL based on a 30-day geometric mean) while operating in constant CT dosing mode. To ensure an exceedance does not occur and that proper dosing is achieved, MWRD is currently operating at a constant initial dose of PAA (1.2 mg/L PAA at the time of this report. This approach has increased PAA chemical costs substantially and has resulted in a re-evaluation of the PAA dosing strategy.

Manoli et al. (2019) proposed a novel CT-based PAA dosing strategy derived from first principals. A double-exponential model of microbial inactivation was solved given a first order model of PAA decay and an n-CSTR hydraulic model. The formulation predicted effluent fecal coliform concentrations given influent fecal coliform concentration and the integrated CT (ICT). ICT was solved given the initial concentration of PAA, the PAA decay constant, and the initial demand of PAA. The PAA decay constant was estimated by solving for various ICTs using Excel Solver and in for Manoli et al. ranged from 0.01-0.02 min-1. Given the average ICT for a given hour, fecal coliform samples were taken at the inlet and outlet to fit the microbial inactivation model. The fitted parameters (β, kd, m, kp) varied with each batch, which demonstrates that the first order model may not fully describe PAA demand and decay kinetics in a real water matrix, requiring four degrees of freedom to fit the model to the observed data.

Alternatives to predicting PAA concentration using first order models are non-deterministic approaches, such as statistical models and neutral network models. Both approaches have the advantage of being able to consider the impact of multiple variables without a known relationship. However, water quality and operational parameters of a wastewater treatment system are too complex for many statistical models (e.g., linear regression, generalized linear models, random forest model, support vector machines). Therefore, neural networks (NN) were used to predict concentrations of PAA throughout the disinfection basin and exponential model fits of the predicted concentrations were used to calculate instantaneous CT.

# Materials and methods

CT is the sum of the area of the curve of PAA concentration as a function of time. Assuming a single exponential model describes the consumption of PAA throughout the disinfection basin, CT is calculated from:

where is the concentration of PAA as a function of hydraulic retention time, is the total hydraulic retention time in the disinfection basin, is the 1st order exponential decay constant, and is the solution to the 1st order exponential decay at . is equivalent to the initial PAA dose minus instantaneous PAA demand (). The curve is fit to two sampling points at the beginning (immediately downstream of dosing) and halfway through the disinfection basin.

* Summarize raw data and merge methods
* Dimensions of basin

# Results

NN Models were built to predict PAA at the “1-min” and “1/2 basin” sample point to predict C1 and C2