ENVIROTECH

CASE STUDY

Control of Pond Algae Utilizing Peracetic Acid City of Modesto, CA

JULY 16, 2003

Introduction

The City of Modesto POTW currently treats an average of 20 MGD of domestic wastewater at the secondary treatment plant. The influent is split and sent to two independent bio-towers. Bio-tower effluent is sent to oxidation ponds then to a 2.2 billion gallon storage reservoir. Effluent from the storage reservoir is used for land irrigation during the summer. Other times of year the storage reservoir effluent is sent to two equalization ponds in route to a 1.5 MG chlorine contactor (CC). At the CC influent, liquid chlorine gas is dosed at 7 to 13 ppm. Ammonia is added as needed to maintain chloramines levels. Effluent from the CC is pH adjusted with hydrochloric acid and dechlorinated with sulfur dioxide. Treated effluent is then directed to the San Joaquin River. River dilution is limited to 20:1.

Rapid urban growth in the City of Modesto and expected permit changes from the State Water Board has resulted in the need for more capacity at the treatment plant. The current storage reservoir has been pushed to capacity resulting in the need to discharge to the San Joaquin River during late spring and early fall. During these periods algae blooms occur in the storage reservoir preventing river discharge. The main problem posed by the algae is high TSS but other problems include high chlorine demand, high pH, and high coliform levels. TSS is limited to 30 ppm but during algae blooms, the TSS can reach over 100 ppm.

Keywords

Algae
Peracetic acid
Chlorine demand
Disinfection
Effluent TSS
Chlorine contactor (CC).

Abstract

Peracetic acid (PAA) was evaluated as an algae control agent at the City of Modesto, CA Publicly Owned Treatment Works (POTW), during the period of June 2–4, 2003. Algae have been a problem at the POTW for many years and have become an increasing problem as the POTW attempts to increase its treatment capacity. High algae levels entering the chlorine contactor cause high chlorine demand, high TSS, and high pH in the chlorine contactor (CC) effluent.

PAA was added to the storage reservoir effluent at a dose of 3 to 6 ppm. Reservoir effluent flow was 7.5 to 15 MGD and passed through two flow equalization ponds with a combined capacity of 3.5 MG. The PAA was fed for a period of 48 hours while measurements of water quality were taken. Measured parameters included BOD, TSS, total coliform, conductivity and pH. Algae were observed for bleaching.

A dose of 6 ppm of PAA was required to kill the entrained algae. Some of the dead algae settled in the equalization ponds and lowered the CC influent TSS by 45%. 3 ppm of PAA did not appear to have any effect on the algae but did lower the chlorine demand in the CC by 50%. A dose of 6 ppm PAA reduced total coliforms by 97% over contact times of 1 to 11 hours. A dose of 3 ppm PAA lowered total coliforms by 91% after one hour but re-growth of coliforms was noted after 5 hours. Lab tests revealed no statistically significant increase in COD, BOD, TDS, or acetate.

Algae control methods

Conventional methods used to control algae include dissolved air flotation (DAF), copper sulfate, shading, and nutrient control. Although effective, these methods involve large capital costs and, in the case of copper sulfate, down stream environmental issues. Peracetic acid (PAA) is an alternative that offers lower cost and less environmental impact. PAA is an effective disinfectant that does not add TDS or disinfection byproducts. PAA breaks down into carbon dioxide and water and so has no down stream impact.

PAA evaluation

PAA 17, a 15% active peracetic acid with 23% hydrogen peroxide and 16% acetic acid, manufactured by Enviro Tech of Modesto, CA was used for the algae control test. PAA 17 was added to the storage reservoir effluent at a dose of 3 to 6 ppm. Reservoir effluent flow was 7.5 to 15 MGD and passed through two flow equalization ponds with a combined capacity of 3.5 MG. The PAA was fed for a period of 48 hours while measurements of water quality were taken. Measured parameters included BOD, TSS, total coliform, conductivity and pH. Algae were observed for bleaching. Water samples were taken at the following points:

Sample point #1: Storage reservoir effluent

Sample point #2: Equalization pond #1 influent

Sample point #3: Equalization pond #1 effluent

Sample point #4: Equalization pond #2 effluent

Sample point #5: Chlorine contactor effluent

Each sample point was measured for COD in order to determine if the acetic acid in the PAA 17 would increase the COD level. TSS was measured in order to determine how effective the PAA was in killing and precipitating algae. Total coliform tests were run in order to determine how well PAA could kill bacteria in a pond system. Other tests run included residual PAA, pH, conductivity, and acetate.

PAA test method: PAA was tested with Hach single analyte meter utilizing DPD (N,N-diethyl-p-phenylenediamine) powder pillows. The 25 ml sample is first treated with a DPD powder pillow then allowed to react for a period of 60 seconds at which time the sample is read. PAA oxidizes the DPD, to form a pink color in direct proportion to the PAA concentration. The detection limit is 0.05 ppm. Accuracy is + or – 2%.

Average Reservoir water Characteristics:

Note that all numbers are in units of mg/1.

TSS	TDS	DO	pH	total coliforms
70	640	3.0	9.5	900

RESULTS

Coliforms: A dose of 6 ppm PAA reduced total coliforms by 97% and fecal coliforms by 99% over contact times of 1 to 11 hours *(figure 1)*. A dose of 3 ppm PAA lowered total coliforms by 91% and fecal coliforms by 94% after one hour but re-growth of coliforms was noted after 5 hours *(figure 2)*. Lab tests revealed no statistically significant increase in COD, BOD, TDS, or acetate.

Algae: Based on visual observations of algae color, a dose of 6 ppm of PAA was required to kill the entrained algae within the six-hour retention time provided by the equalization ponds just upstream of the CC. Some of the dead algae settled in the equalization ponds and lowered the CC influent TSS by 37% *(figure 3)*. 3 ppm of PAA did not appear to have any visual effect on the algae but increased the secci disk visibility depth from 8 inches to 12 inches *(figure 4)* and lowered the chlorine demand in the CC by 50%.

PAA decay rate: At a PAA dose of 3.0 ppm, the PAA decayed with a half-life of approximately 60 minutes *(figure 5)*. Lab tests confirmed the decay rate. At a dose of 6.0 ppm and a flow of 7.5 MGD, a PAA residual could not be measured at sample point 4 due to the increased retention time (from 5.6 hours to 11.2 hours).

Summary: The TSS reduction as a result of the PAA treatment was significant. The TSS was reduced to 45 ppm and the goal was 30 ppm. Because the PAA did not reduce the TSS below the goal level, the test was discontinued. However, the PAA test did show that PAA could be used to reduce TSS loading caused by algae. Factors that worked against the efficacy of the PAA included high reservoir water pH, high ambient air temperatures, and intense sunlight.

FIGURE 1:

City of Modesto PAA Evaluation, Total and Fecal Coliforms as a Function of Sample Point

(6 ppm PAA)

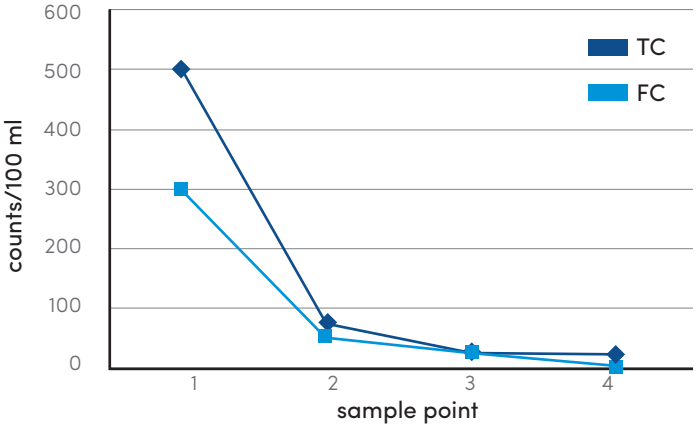


FIGURE 2:

Total and Fecal Colidorm as a Function of Sample Point

(3 ppm PAA)

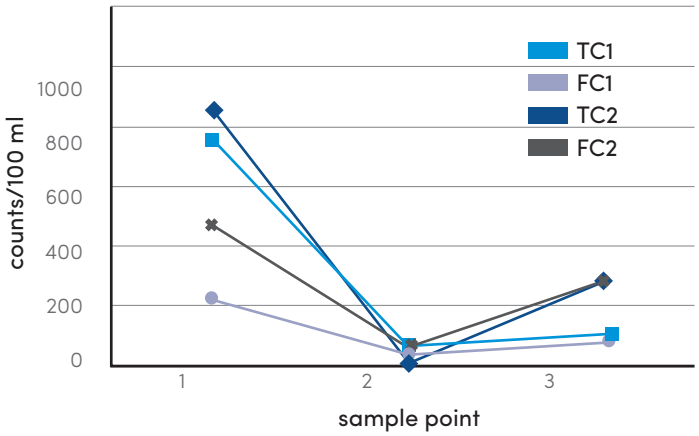


FIGURE 3:

TSS vs Sample point

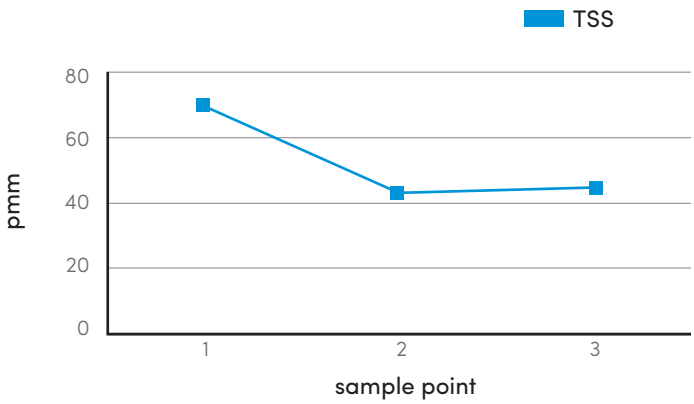


FIGURE 4:

Secci Dish Depth vs Sample Point

(Average Values)

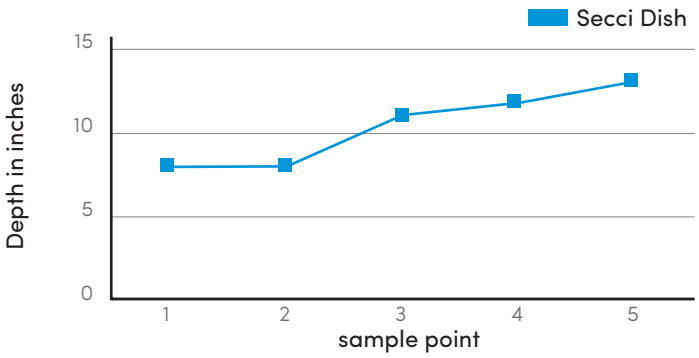
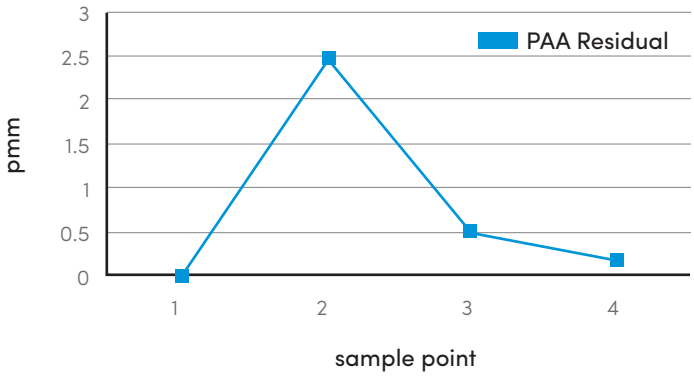


FIGURE 5:

PAA residual vs sample point



CONCLUSION

PAA has shown to be an effective algae control tool at the City of Modesto. Although the PAA did not meet the desired 90% TSS reduction goal, 6 ppm of active PAA fed to the reservoir effluent resulted in a TSS reduction of 37% across the equalization ponds. A 97% reduction of total coliform and 99% reduction of fecal coliform bacteria with no re-growth was also noted. 3 ppm of PAA had no apparent effect on the algae but did reduce total coliforms by 93% and fecal coliforms by 94%. Other benefits of the PAA included lowered chlorine demand in the CC and lowered TSS and total coliforms in the CC effluent. PAA showed no statistically significant increase in COD, BOD, TDS, or acetate.

WASTEWATER ALGAE COMPARISON

3ppm Perasan After 2.5 hours