Chlorine disinfection of wet weather managed flows

Laura A. Boczek[1*], Cliff H. Johnson[1] and Mark C. Meckes[1]

[1]United States Environmental Protection Agency, Cincinnati, Ohio 45268
[*] Corresponding author Email: boczek.laura@epa.gov

ABSTRACT

Blending is a practice used in the wastewater industry to deal with wet weather events when the hydraulic capacity of the treatment facility could be compromised. Blending consists of primary wastewater treatment plant effluent, partially bypassing secondary treatment, and then being recombined or "blended" with disinfected secondary effluents before disinfection and discharge into the receiving waters. Bench scale blending experiments were performed in this study with different ratios of primary to secondary treated wastewater (5:5, 3:7, and 1:9). Blended effluents were disinfected with sodium hypochlorite at two different concentrations and evaluated for microbiological indicators. Results indicate that disinfection of blended waste water is sufficient to reduce indicators such as fecal coliforms; however, bacterial viruses are more resistant and persist in samples with higher concentrations of primary effluent.
KEYWORDS: Blending waste water, disinfection waste water

INTRODUCTION

Flow to publicly owned treatment works (POTW) increases during wet weather events due to intrusion of storm water into sanitary collection systems and use of combined sewer systems. When such flows exceed the hydraulic capacity of a POTW, alternate flow management techniques must be employed to ensure that the integrity of the unit processes is not compromised. One technique is to treat influent flows through primary clarification and limit the flow to the secondary treatment units to design limits. Excess flow from the primary clarifiers, which by-passes secondary treatment, is then recombined or "blended" with secondary effluents and disinfected. During the blending process, particulate matter within primary effluent can reduce the effectiveness of disinfection. It is possible that the size of these particles relates to the degree of protection observed for microbes during the disinfection step. In addition, ammonia, and other related organic compounds in blended waste waters, reacts with chlorine producing chloramines and other combined chlorine species, which reduce the disinfectant's effectiveness for killing or inactivating pathogens. The objectives of this work were to determine the effectiveness of chlorine disinfection on a variety of microbial indicators within blended effluents, and to compare the disinfection results with

specific water quality parameters for the purpose of developing a model for chlorine disinfection of blended effluents.

METHODOLOGY

Samples of primary and undisinfected secondary effluents were collected from 3 local conventional activated sludge wastewater treatment plants (WWTP). The effluents for each plant were then mixed thoroughly but gently at three different ratios, 1:9, 3:7, and 5:5, to produce blended effluents. Samples of primary and secondary effluents, and each of these blended products, were assayed for indicator organisms (fecal coliforms, *Escherichia coli*, enterococci, total heterotrophs and somatic and male-specific coliphage), suspended solids, turbidity, total organic carbon, ammonia, redox potential, pH and temperature (1, 2, 3). Blended effluents were then mixed with a dilute sodium hypochlorite solution to a final total chlorine concentration of approximately 2.0 and 5.0 milligrams per liter (mg/L) and sampled after 30 minutes of contact time. Sodium thiosulfate was then added to the sterile sample vessel to immediately quench chlorine oxidation. Samples were then assayed for microorganisms as described above.

RESULTS

Preliminary results from 1 WWTP show that the total suspended solids for the 5:5, 3:7, and 1:9 blended samples were 33.3, 18.3, and 13.7mg/L, respectively. The turbidities of the blended samples were 19.3, 10.9, and 5.45 Nephelometric Turbidity Units. After 30 minutes at 2 parts per million (ppm) total chlorine, fecal coliforms, *Escherichia coli (E. coli)*, and enterococci were reduced by 99.53% or better in all blended samples; heterotrophic bacteria were reduced by 69.45% or more in all blended samples; and coliphage were reduced 64.29% in the 5:5 blended samples and 80.99% in the 1:9 samples. Similar results were obtained at the other WWTP sites. After 30 minutes at 5 ppm total chlorine, fecal coliforms, *E. coli*, and enterococci were again reduced by 99.98 percent or more; heterotrophic bacteria densities were reduced by 97.85% or more in blended waters; and somatic coliphage was reduced by 64.84% in 5:5 blended samples and 90.57% in 1:9 blended samples. Figures 1 and 2 show the respective log removals of microbiological indicators at either 2 ppm or 5 ppm total chlorine after 30 minutes. These data clearly illustrate that there is a greater removal of indicators such as fecal coliforms, *E. coli*, and enterococci, while heterotrophic bacteria and coliphages are more resistant to chlorine disinfection. Similar results from the other WWTP sites will be discussed during the presentation.

DISCUSSION

This data shows that chlorination of blended effluents was highly effective in reducing the number of conventional indicators such as fecal coliforms. It also demonstrates that the increased amount of primary effluent reduces the ability of the disinfectant to kill or

inactivate the coliphage population; suggesting that other viruses may also survive chlorination.

It is known that ammonia and other organic compounds in wastewater effluents react with chlorine reducing the ability of the disinfectant to kill or inactivate microbes. It is likely that disinfection of blended wastewater effluents is affected by physical and chemical properties. Particulate matter in primary effluents is thought to inhibit the direct contact of disinfecting agents and microorganisms. Such a shielding effect may be more significant for virus than for bacteria.

NOTICE

The U.S. Environmental Protection Agency, through its Office of Research and Development, funded and managed, or partially funded and collaborated in, the research described herein. It has been subjected to the Agency's peer and administrative review and has been approved for external publication. Any opinions expressed in this paper are those of the author (s) and do not necessarily reflect the views of the Agency, therefore, no official endorsement should be inferred. Any mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Figure 1

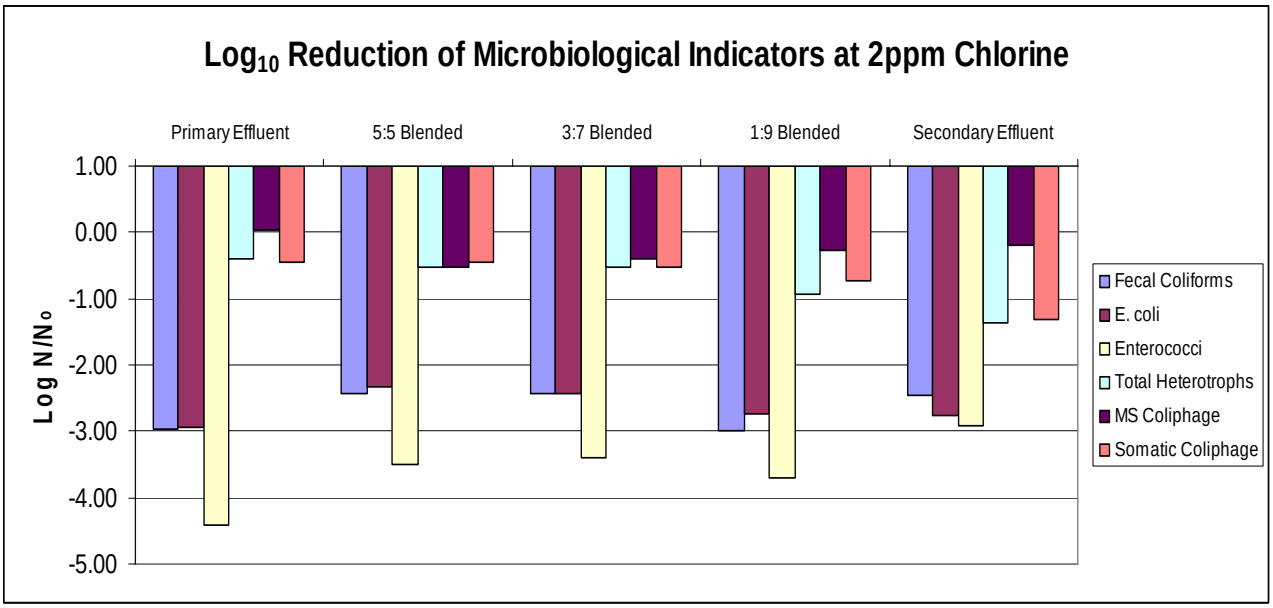

Figure 2