

# Cuatro Comunidades Chlorination

## Chlorination

### Introduction and Objectives

Chlorination is the final step in the treatment process. Chlorine disinfects the effluent, killing whatever pathogens may remain. AguaClara plants use a [flow control module \(FCM\)](#) to regulate chlorine dose (figure 1).

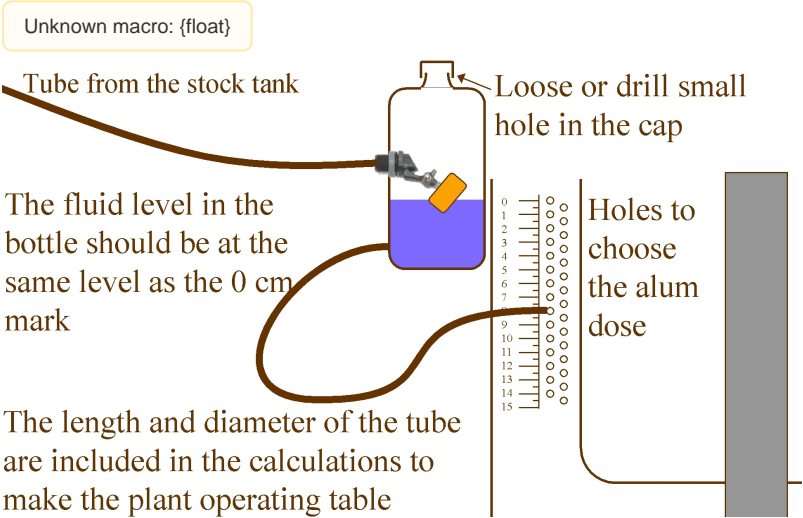


Figure 1: flow control module schematic

The chlorine flow is driven by available head in the FCM and the dose is changed by increasing or decreasing this available head. Chlorine is added in the plant before water is sent to the distribution line. The residual from this chlorine should guarantee protection from pathogens along the distribution line. In this study, the chlorine residual was measured daily in the storage tank, and three houses along the distribution line. Additionally, samples were taken from the storage tank and the chlorine residual was measured in them over time. The flow rate in the chlorinator was measured to make sure the FCM was delivering the expected dose.

### Methods

Chlorine residual was monitored daily in four locations in the distribution system--- The tank, the first house in the distribution line, a house in the middle of the line and the last house in the line. Chlorine residual was measured with a Pentair Pool Products™ Pool and Spa Test Kit which used ortotolidine to detect chlorine. However, it should be noted that the test is a fairly subjective colorimetric test and that the measurements were taken by three different people. Therefore the results only show relative levels of chlorine not exact amounts. To measure how long the chlorine residual lasts at different effluent turbidities water samples were taken from the storage tank and then the residual was measured.

The chlorine flow rate was measured using the same clear PVC piping used for the CDC (See [CDC methods](#) section). The actual flow rates were measured before and after cleaned the hosing in the FCM. Each trial was performed three times consecutively and the average of these trials was taken to be the flow rate.

### Results and Discussion

Monitoring the chlorine residual along the distribution line was a good method of ensuring that that water was safe to drink. The residence time from the plant to the end of the distribution line depends on the demand on the system making it difficult to determine how long the chlorine residual lasts. Furthermore, samples were not taken at the same time each day at each location. More information about chlorine residual was gained from the samples taken from the tank. An effluent sample with turbidity of 26.49 NTU and an initial chlorine residual of 1.5 mg/L had measurable chlorine residual for fifteen and a half hours. At this point the residual was 0.3 mg/L. Effluent samples with less than 4 NTU turbidity and chlorine concentrations of 1.5 mg/L taken on different days contained detectable chlorine for over

The actual flow rate through the FCM was compared to the theoretical flow rate (figure 1).

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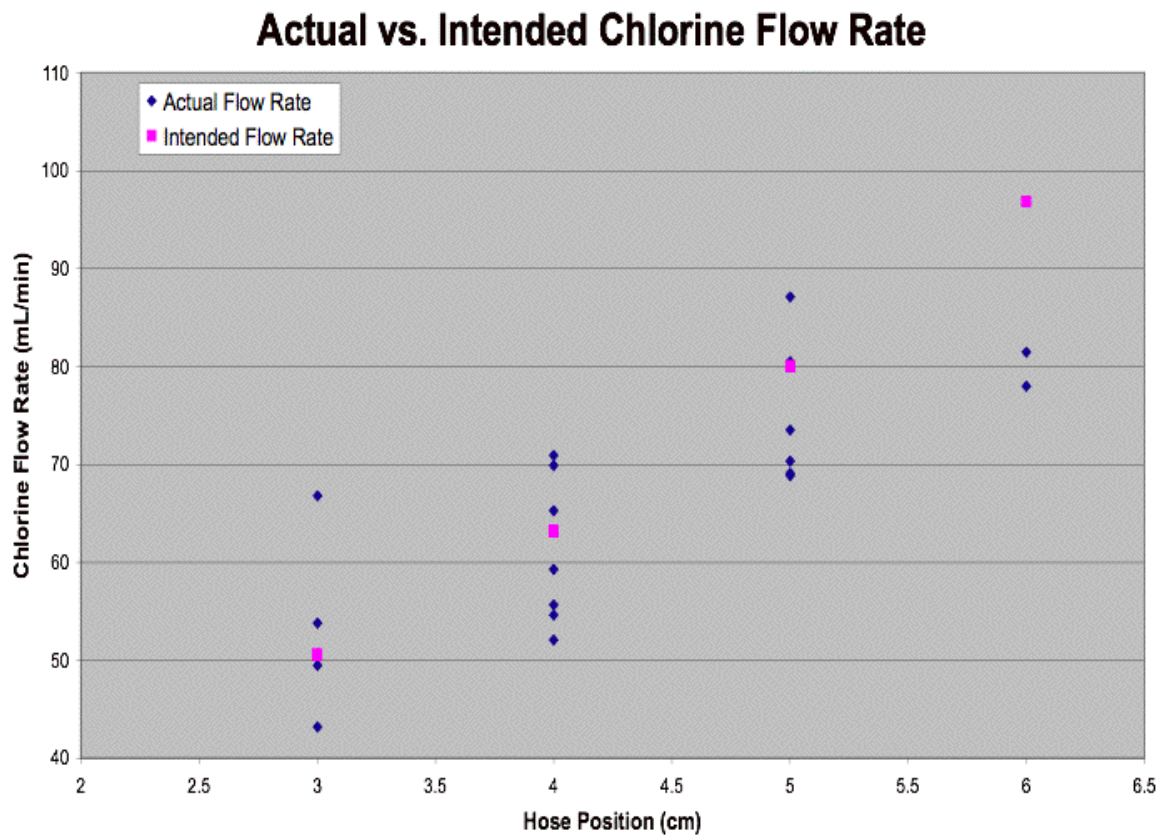


Figure 2

The measured flow rates are probably different because the hose was not always cleaned before each trial was run. After cleaning the flow rate was close to the expected trend (figure 3).

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## Actual vs. Intended Chlorine Flow Rate

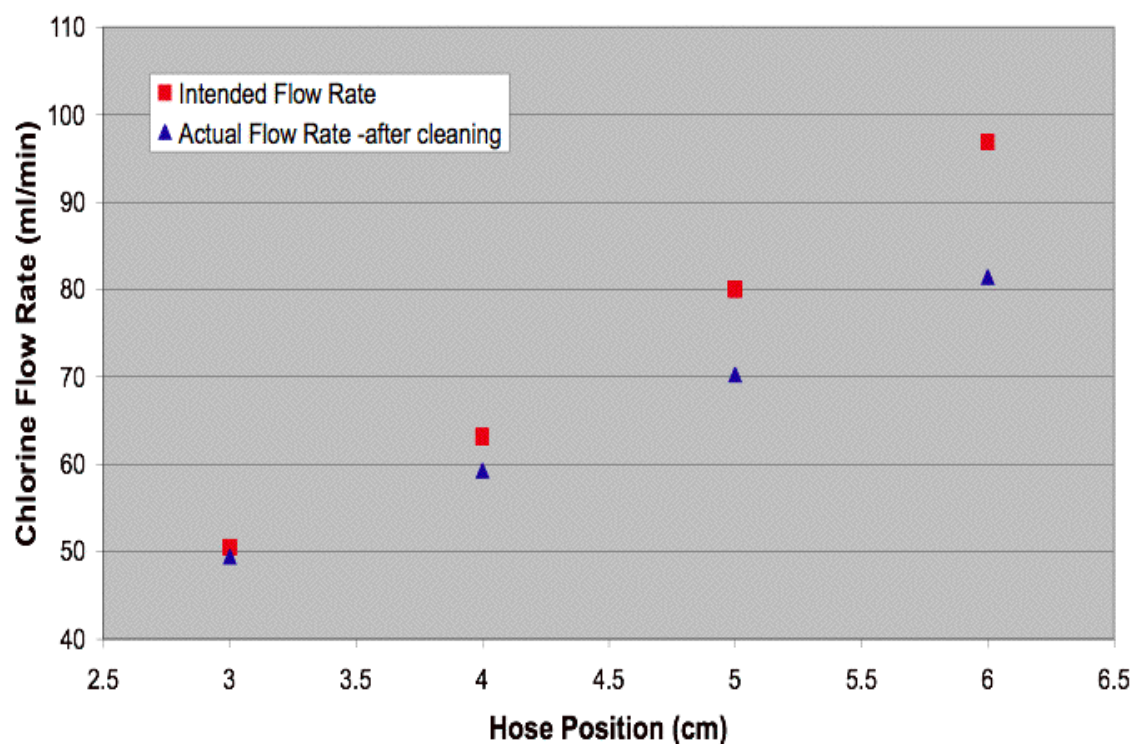


Figure 3

Initially the chlorine flow rate matches the expected flow rate, but as the available head increases the flow rate is unable to reach the expected maximum flow rate. This problem was also seen in the CDC tubing and can easily be fixed by shortening the FCM tubing and therefore decreasing the head loss in the system. This data also stresses the importance of cleaning the system to obtain an accurate chemical dose.

## Conclusions

The chlorine residual should last at least 15 hours if the turbidity is under 26 NTU. The turbidity going to the distribution system should always be below 10 NTU so this condition should always be met. The FCM needs to be kept clean to ensure the correct dose is being given. Additionally the FCM hosing should be shortened to decrease head loss and increase the maximum flow rate.