Chloramine Optimization through Proper Mixing and a Unique Chloramine Management System

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EPA has set a compliance date of April 1, 2016 but some states are accelerating their compliance

EPA
United States Environmental Protection Agency

Revised Total Coliform Rule: A Quick Reference Guide

Overview of the Rule

Title*	Revised Total Coliform Rule (RTCR) 78 FR 10269, February 13, 2013, Vol. 78, No. 30
Purpose	Increase public health protection through the reduction of potential pathways of entry for fecal contamination into distribution systems.
General Description	The RTCR establishes a maximum contaminant level (MCL) for *E. coli* and uses *E. coli* and total coliforms to initiate a "find and fix" approach to address fecal contamination that could enter into the distribution system. It requires public water systems (PWSs) to perform assessments to identify sanitary defects and subsequently take action to correct them.
Utilities Covered	The RTCR applies to all PWSs.

* This document provides a summary of federal drinking water requirements; to ensure full compliance, please consult the federal regulations at 40 CFR 141 and any approved state requirements.

Public Health Benefits

Implementation of the RTCR will result in:

- A decrease in the pathways by which fecal contamination can enter the drinking water distribution system.
- Reduction in fecal contamination *should* reduce the potential risk from all waterborne pathogens including bacteria, viruses, parasitic protozoa, and their associated illnesses.

To ensure compliance many water utilities are turning to chloramines for use in their distribution networks

- Chloramines have a longer residual life in distribution systems than chlorine
- Chloramines are less prone to DBP formations
- About one third of public water systems are already using chloramines for secondary disinfection

dc water is life

Santa Clara Valley Water District

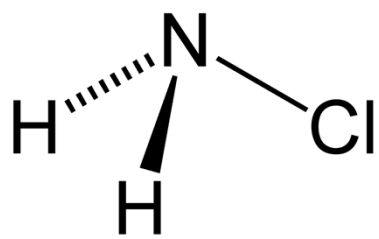
CITY OF Tulsa
A New Kind of Energy.

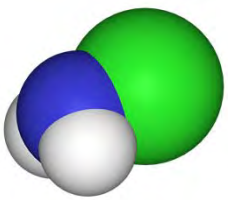
Chloramine usage has been problematic due to accurately controlling ammonia and chlorine dosage in a dynamic system

- Introduction of ammonia can lead to nitrification as it is a nutrient
- Over-chlorination can create chloramine variants which lead to taste and odor problems in drinking water
- Low oxidation levels in addition to nitrification can lead to costly mitigation efforts such as:
  - Chlorine burns
  - Line flushing
  - Water wasting
  - Corrosion control measures

What is Chloramine?

$$NH_3 + OCl^- \longrightarrow NH_2Cl + HO^-$$





Monochloramine is formed by the reaction of chlorine and ammonia with a chlorine atom substituting for one of the three ammonia hydrogen atoms

Chloramine has three variants – only one of which is desirable in a water system

(1) $HOCl + NH_3 \leftrightarrow NH_2Cl + H_2O$
monochloramine

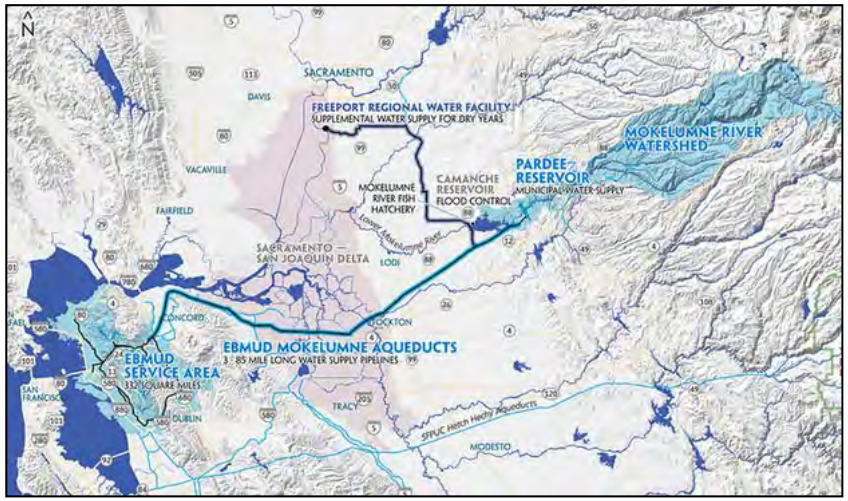
(2) $HOCl + NH_2Cl \leftrightarrow NHCl_2 + H_2O$
dichloramine

(3) $HOCl + NHCl_2 \leftrightarrow NCl_3 + H_2O$
trichloramine

Only monochloramine is considered a suitable disinfectant

In a “real world” water system, chloramine levels are challenged by a number of factors:

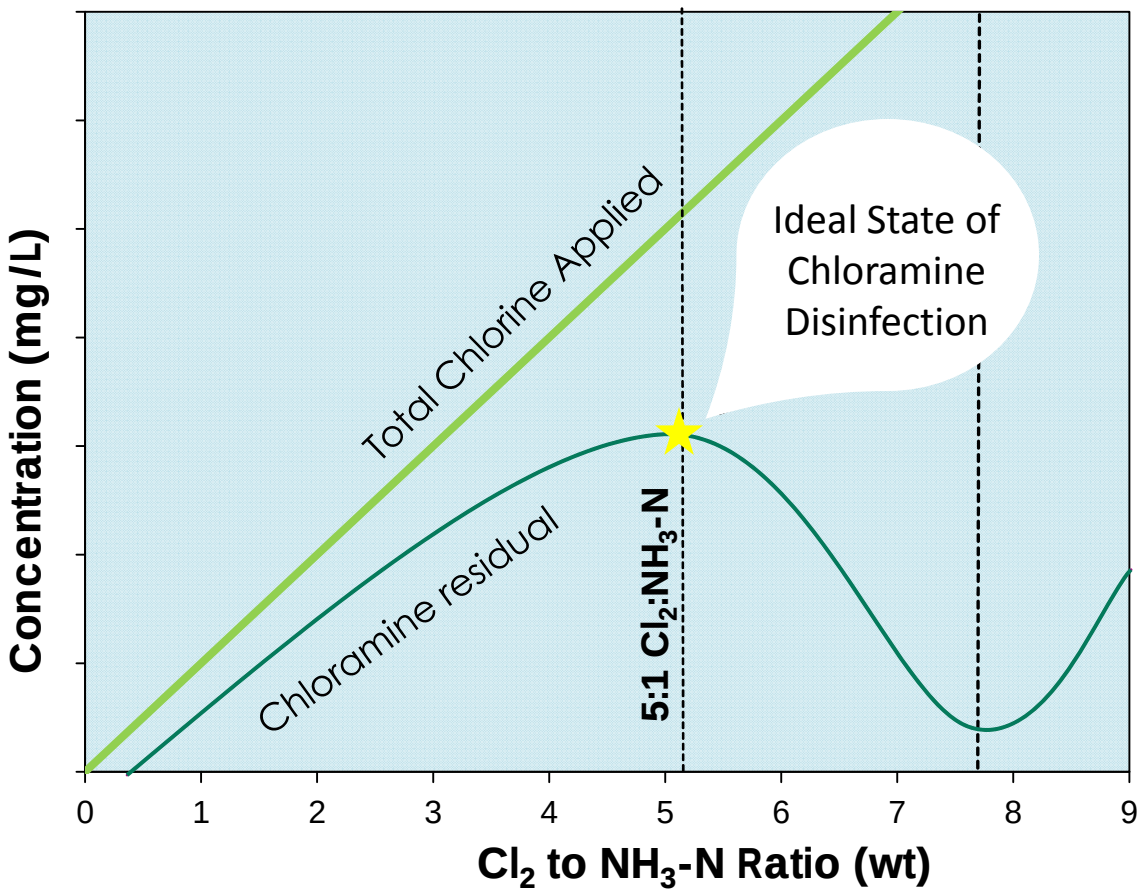
- Temperature stratification in reservoirs and tanks
- Chemical stratification in reservoirs
- Imported or mixed water compatibility
- Water aging in pipelines and reservoirs



Four criteria must be met for proper chloramine control:

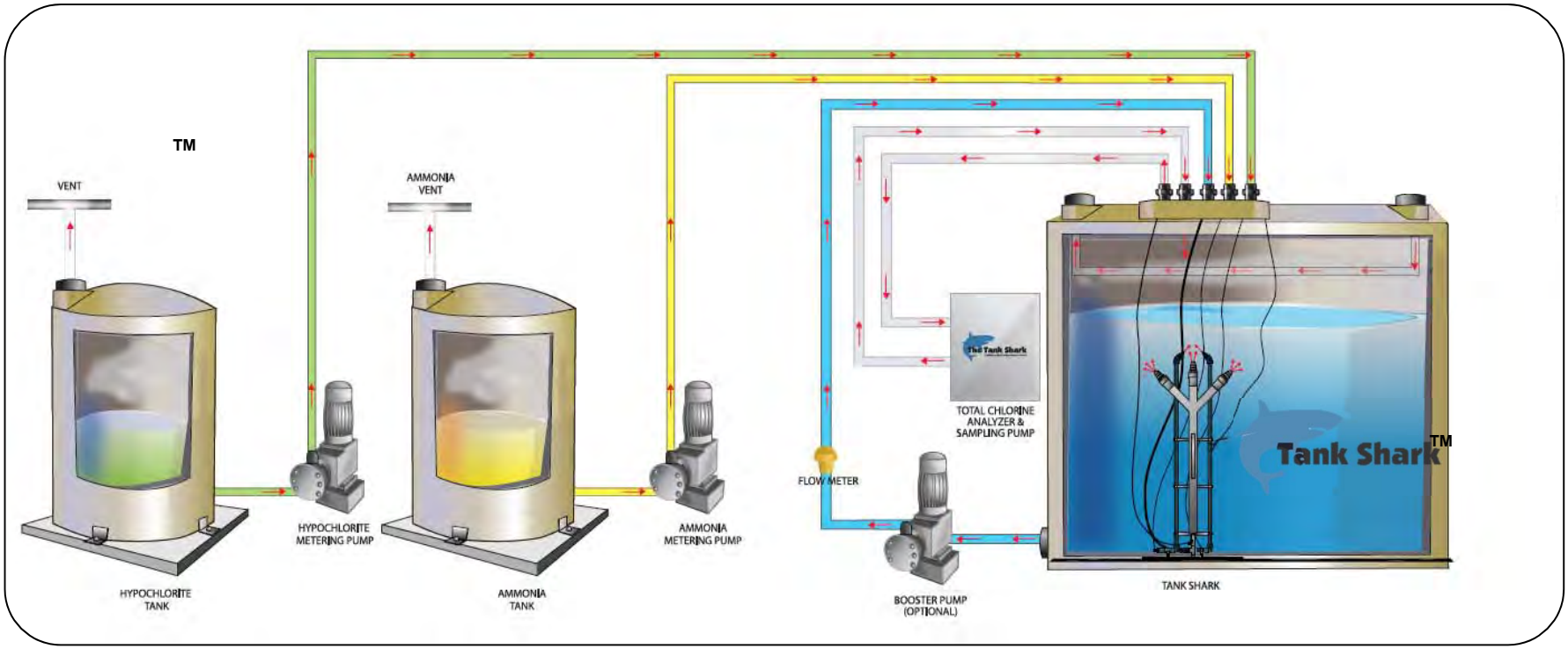
1. Accurate dosing of ammonia and chlorine to ensure proper ratio
2. Proper mixing to ensure a homogenous water body that will not stratify
3. High energy mixing that ensures instantaneous reaction of introduced chemicals
4. Real-time monitoring and control logic to maintain or achieve equilibrium by responding to dynamic reservoir conditions

Chloramine Breakpoint Curve: Know where you are on the curve



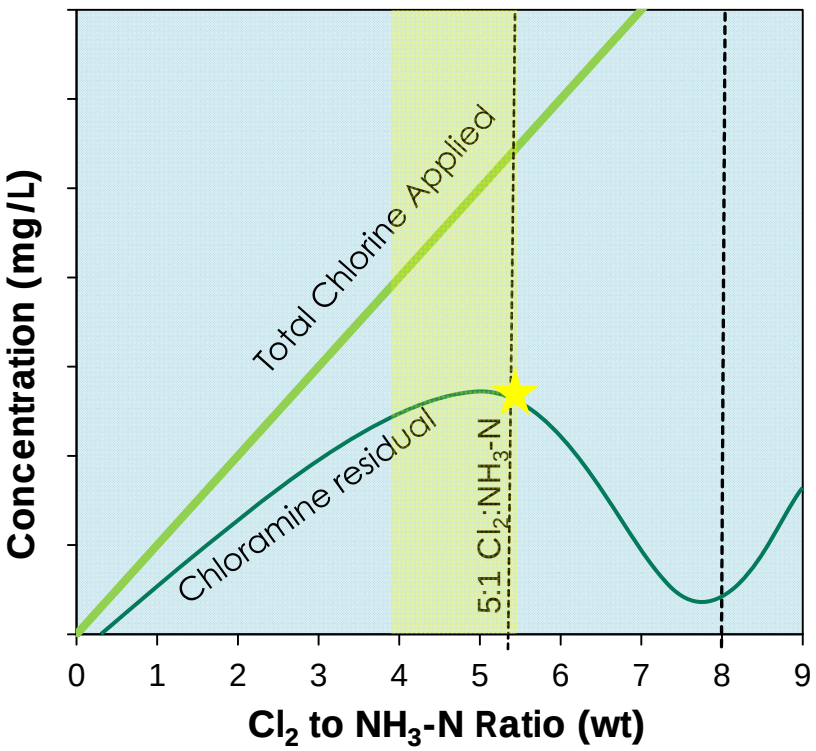
Tank Shark™ System

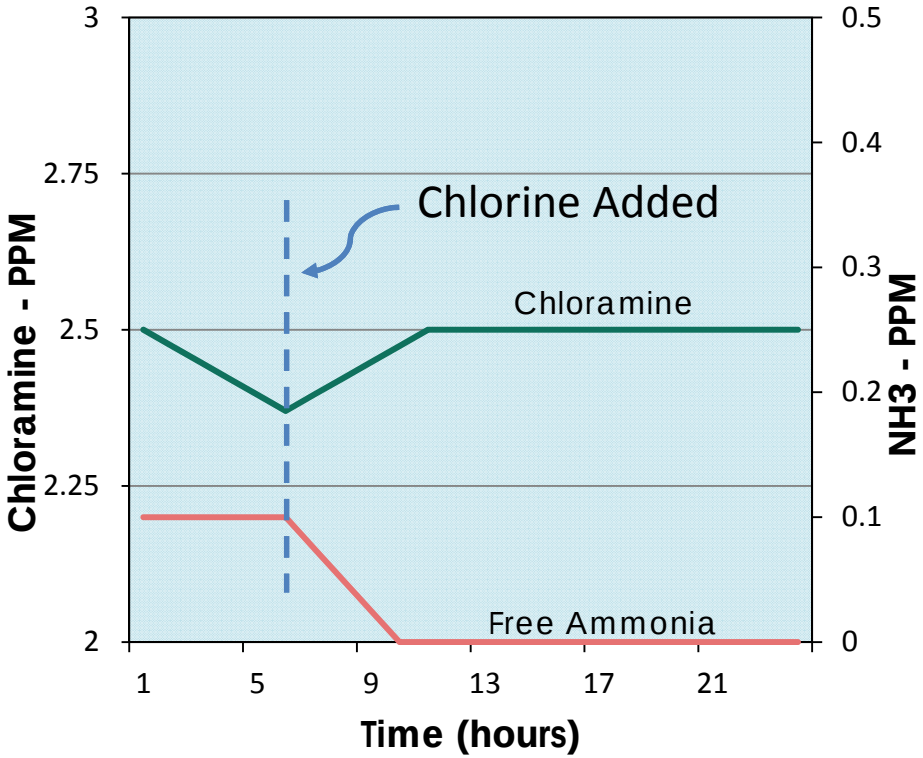
CHLORAMINE MANAGEMENT SYSTEM



The Tank Shark™ Chloramine Management System:

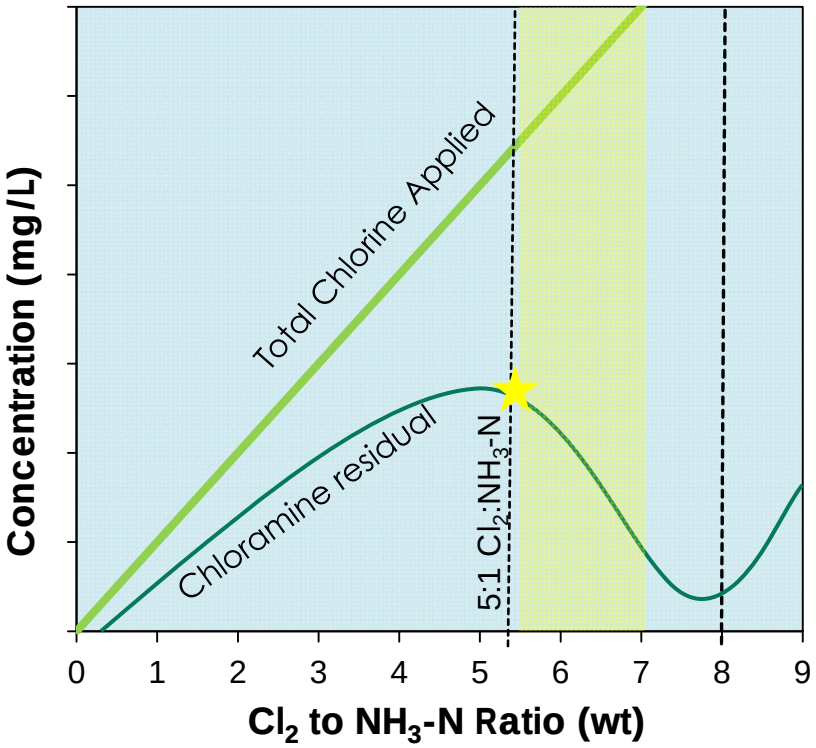
Reservoir Condition: Free Ammonia Present

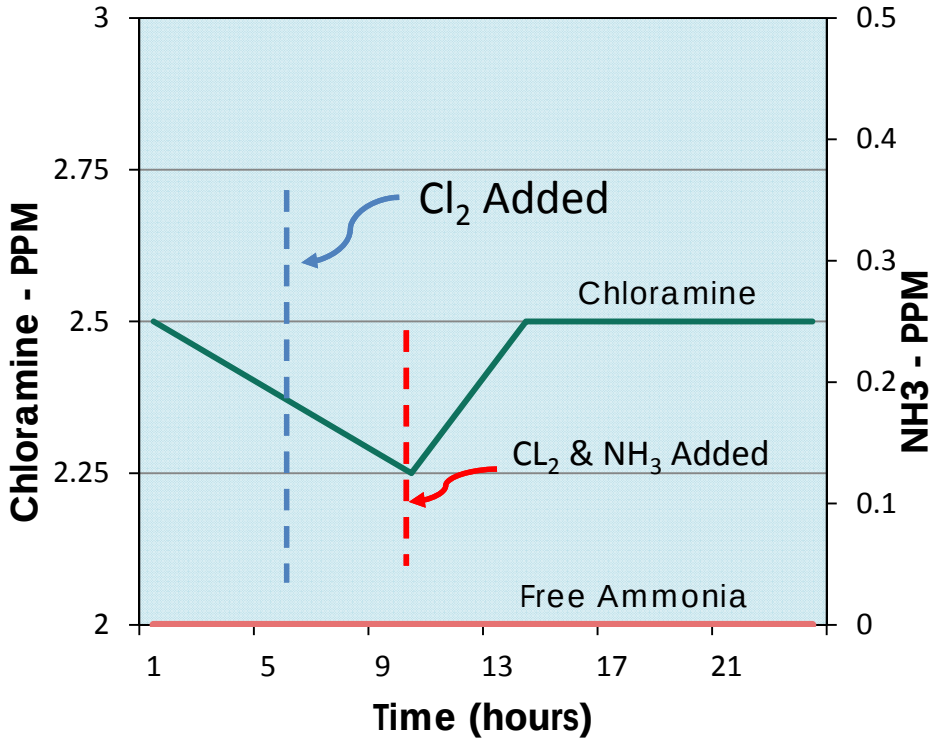




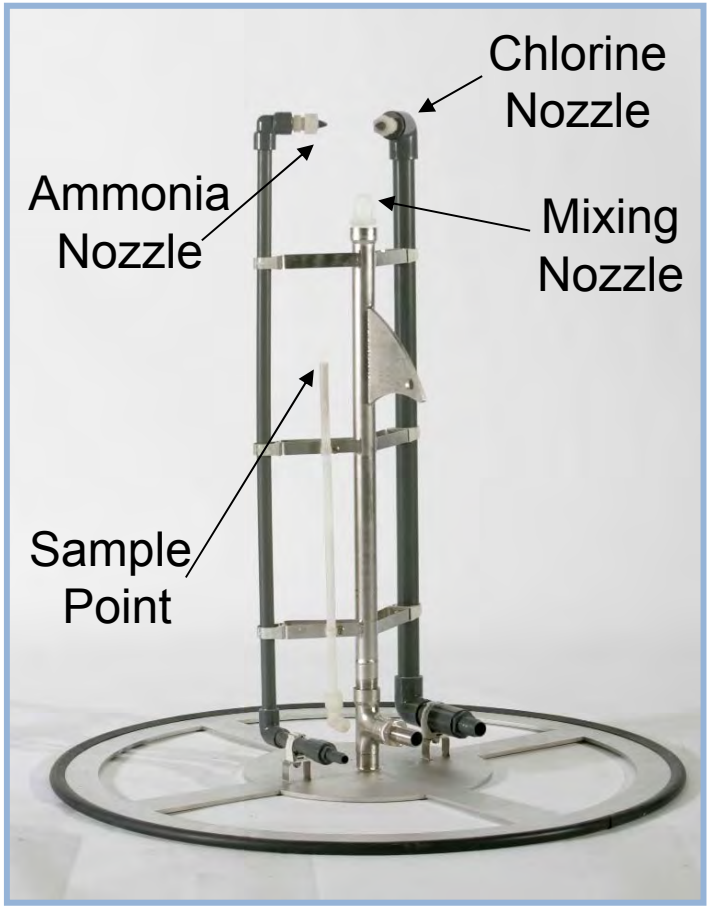
The Tank Shark™ Chloramine Management System

Reservoir Condition: No Free Ammonia Present





Tank Shark™ hardware is simple and easy to maintain

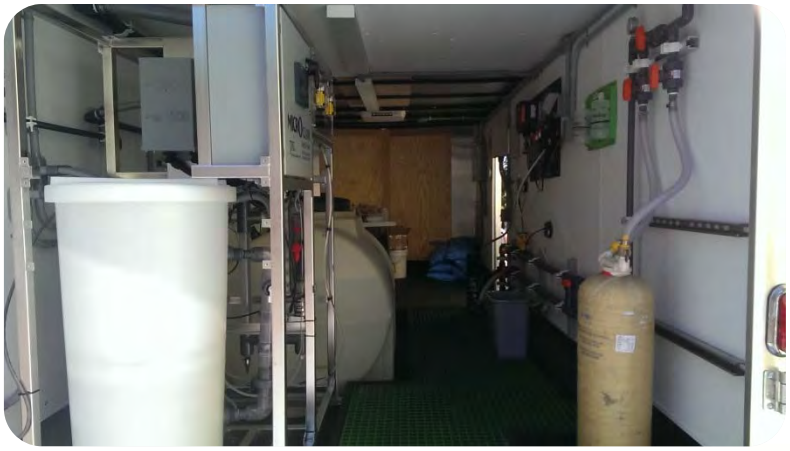


- **Mixing – no electrical service**
- **Integral Sampling Point**
- **Chemical Injection**
  - **Onsite Sodium Hypochlorite (0.8%)**
  - **Commercial Bleach (12%)**
  - **Chlorine Gas**
  - **Aqueous Ammonia or Liquid Ammonium Sulfate (LAS)**

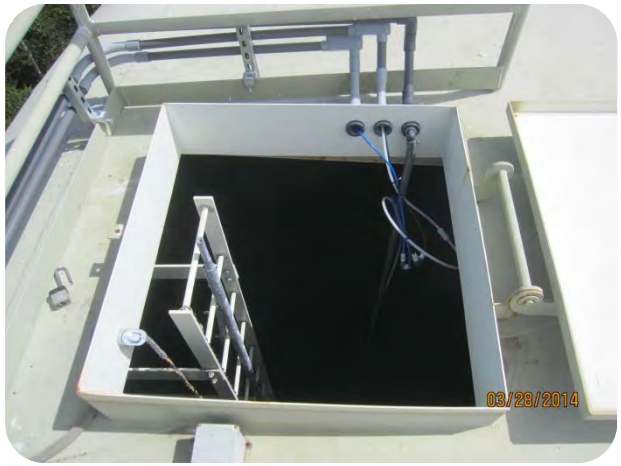
San Jose Water (CA) – Case Study

Pilot System: Tank Shark™ Trailer at San Jose Water

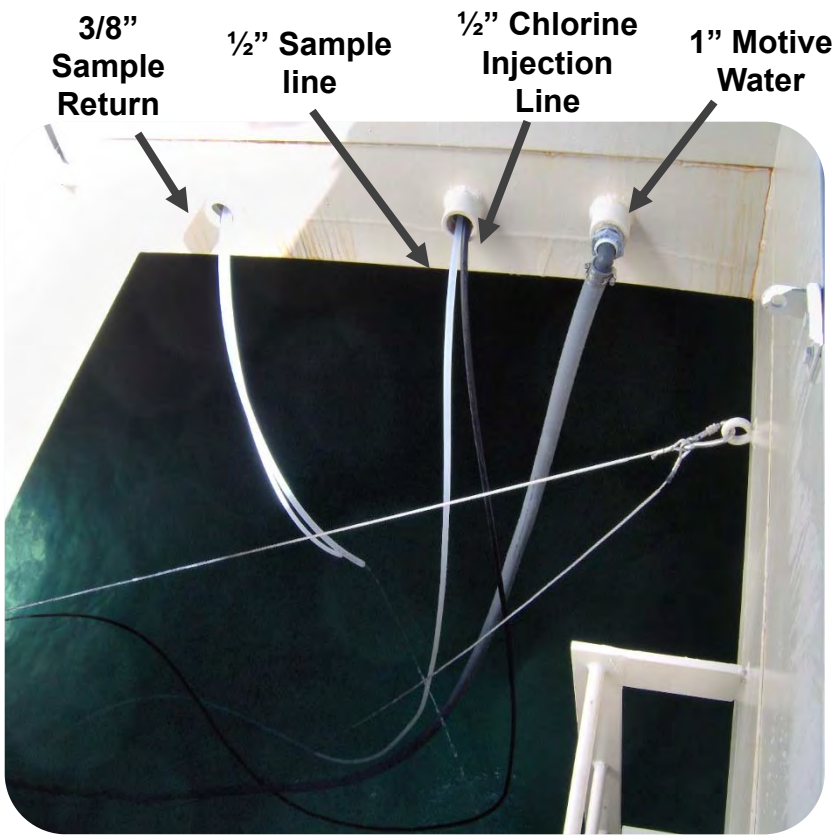
Size: 1 MG
Turnover: 4 days
Problem: Chronically low residual (0.2 mg/L)
Solution: Tank Shark™ with Chloramine Generation



Site conditions in San Jose: Tank Shark™ mixing hardware – no moving parts in tank

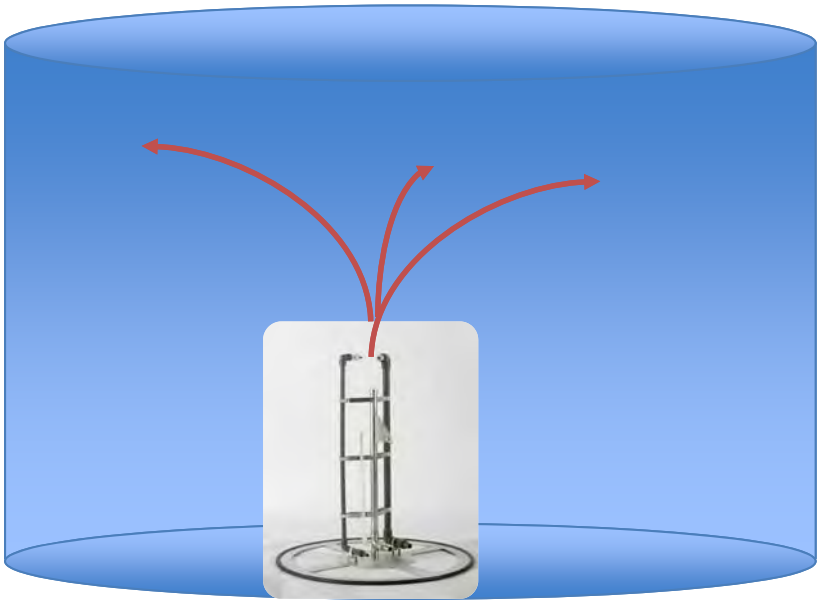


Tank Shark™ was installed while the tank was in service



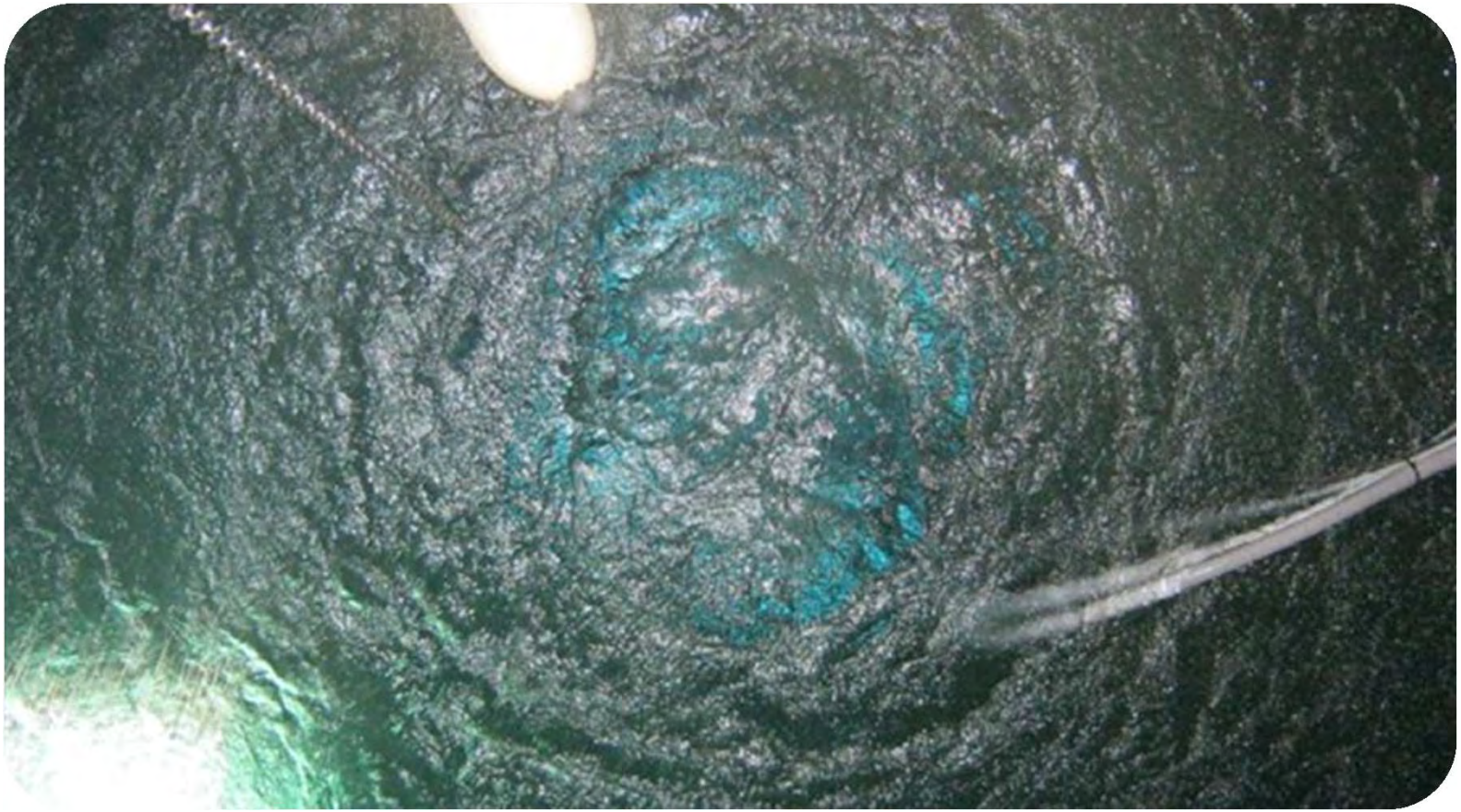
TANK & HATCH PENETRATIONS

Introduction of chemicals into the high energy mixing zone ensures instantaneous reaction



Underwater Photo shows Chemical Entrainment

Moving water on the tank surface indicates active and energetic mixing

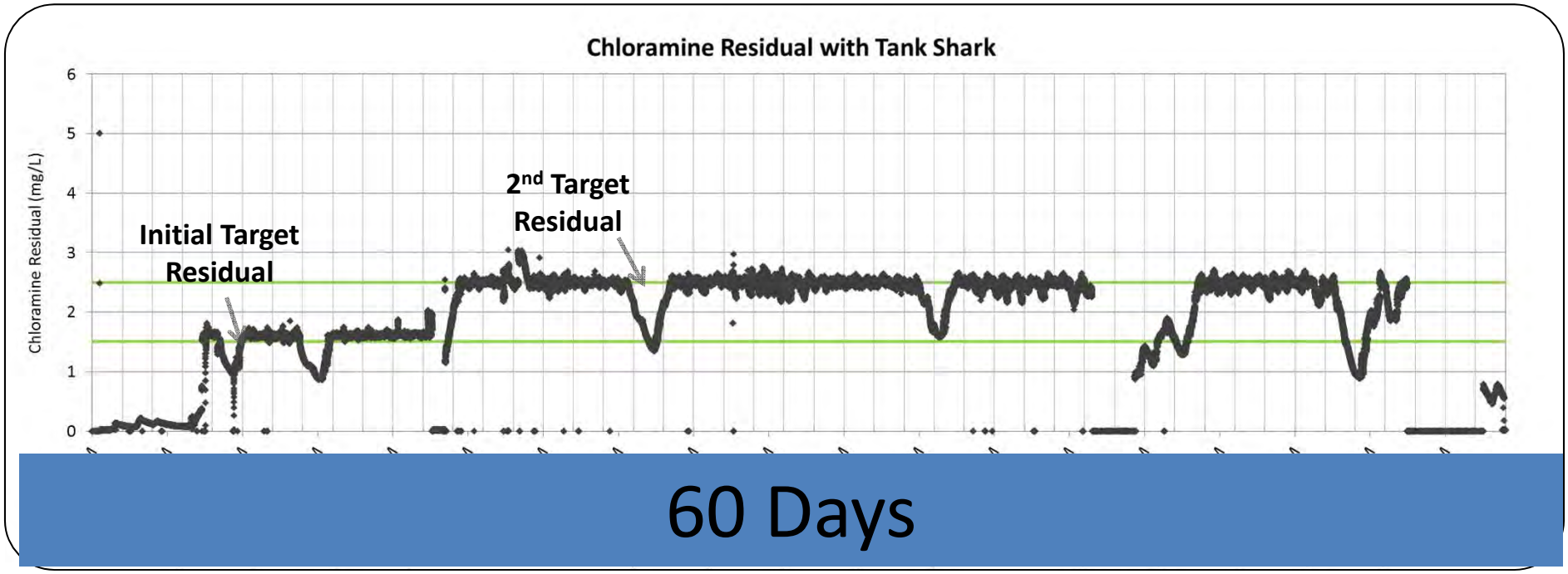


San Jose Tank Surface 2014

Tank Shark™ hardware installation options - suspended

The suspended nozzles are not attached to anything within the tank, allowing for easy maintenance and accessibility.

Tank Shark™ Chloramine Management System Results



Imported water introduced in high quantities throughout the trial caused momentary and intermittent concentration changes followed by quick recovery

Tank Shark™ Chloramine Management System Results

"I wasn't convinced that PSI's Tank Shark™ dosing system would solve our problems after several failed attempts to improve residual, but with PSI offering a trial including installation, operation, and troubleshooting for three months, I had nothing to lose. The system achieved the target residual onsite on the first day, and after making some operational changes to our system, we were able to keep stable disinfectant residuals in the downstream zone as well. PSI was fast, efficient, and responsive, and we are currently in design to install several more of their products across our distribution system."

- SJW Water Quality Engineer

San Jose Water: Benefits of the Tank Shark™ Chloramine Management System

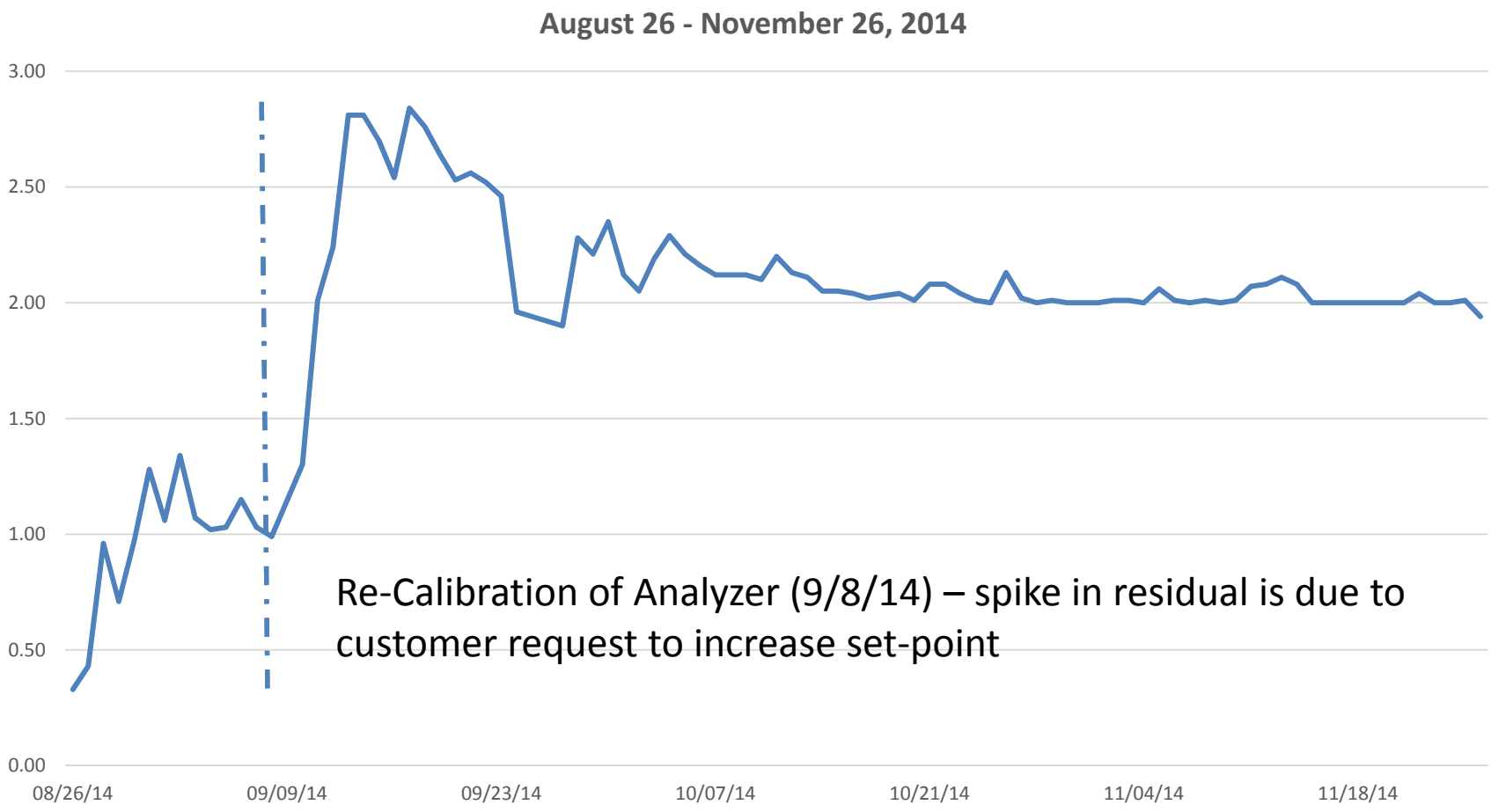
- Installation was accomplished in a day
- No internal energy supply required
- No penetration of the tank roof required
- Positive results occurred within 24 hours
- Maintained set points automatically
- Handled difficult imported water spikes quickly

San Jose Water: Additional Benefits

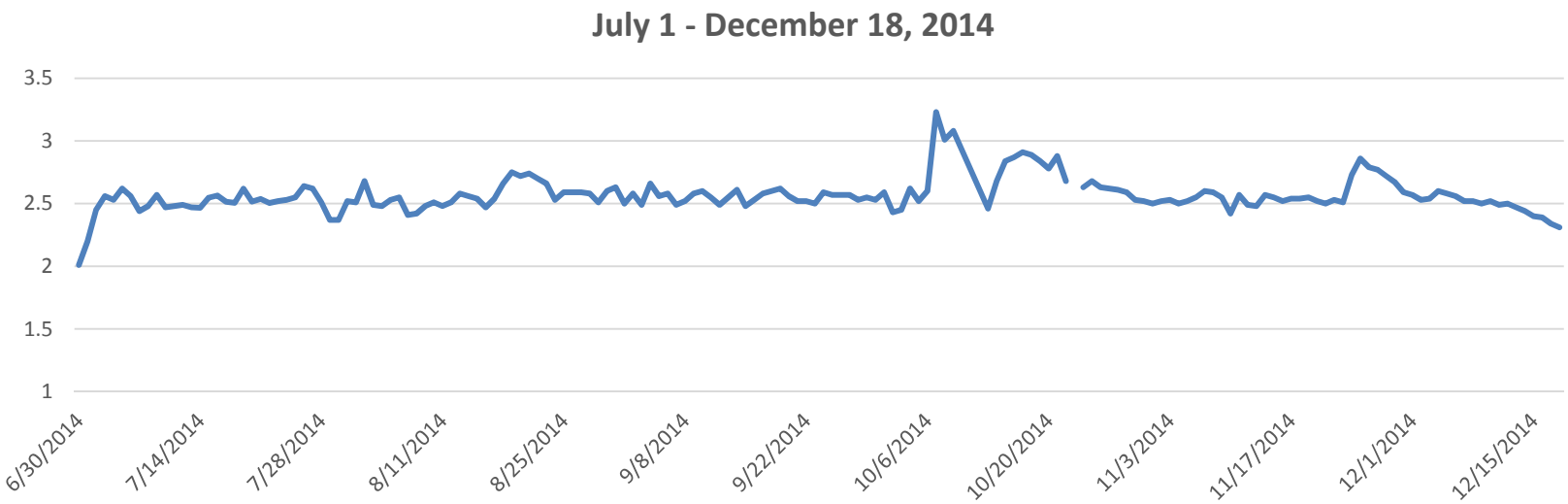
- Elimination of reservoir cycling increases utilization of existing infrastructure and benefits fire protection
- Significant water quality improvements
- Minimizes hazardous material exposure
- Safer operator conditions and environment

SAN JOSE WATER COMPANY

Case Study: Large Northern California Utility



Case Study: Large Southern California Utility



Six month pilot of 10 million gallon above ground storage reservoir

Summary: Chloramine management does not have to be overly complicated

Optimal chloramine management systems have:

- Effective chemical dosing equipment
- Energetic mixing to ensure rapid incorporation of the chemicals
- A high-shear turbulent induction point to ensure rapid reaction of the chemicals
- A proper control algorithm to monitor and adjust the residuals in real time

Tank Shark™

Tank Shark™

Questions?

THANK YOU