THM Analysis – From Compliance to Optimization

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ENGINEERING YOUR SUCCESS.

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Disinfection Byproducts (DBP)

*"Disinfection byproducts are formed when **disinfectants** used in water treatment plants react with bromide and/or **natural organic matter** (i.e., decaying vegetation) present in the source water."*

-US Environmental Protection Agency

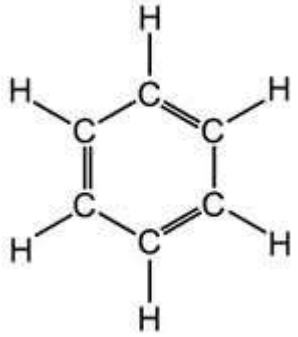
Types of DBP

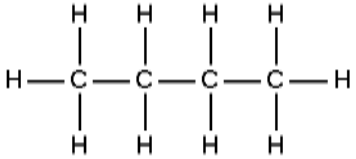
- **Trihalomethane (THM)**
- Haloacetonitriles
- Bromate
- Haloacetic Acid (HAA5)
- Chlorite
- NDMA

Disinfection By-product (DBP) Formation

$$Cl_2/\text{Chloramine} + \text{Organic Carbon} = \text{DBP}$$

- DBP formation – Treatment Facility
  - -Make up and reactivity of organic carbon
    - -Aliphatic
    - -Aromatic
  - -Quantity, type and point of disinfection injection
  - -pH of the water
- DBP formation – Distribution System
  - -Retention time of water
  - -Temperature
  - -Characteristics of pipe deposit

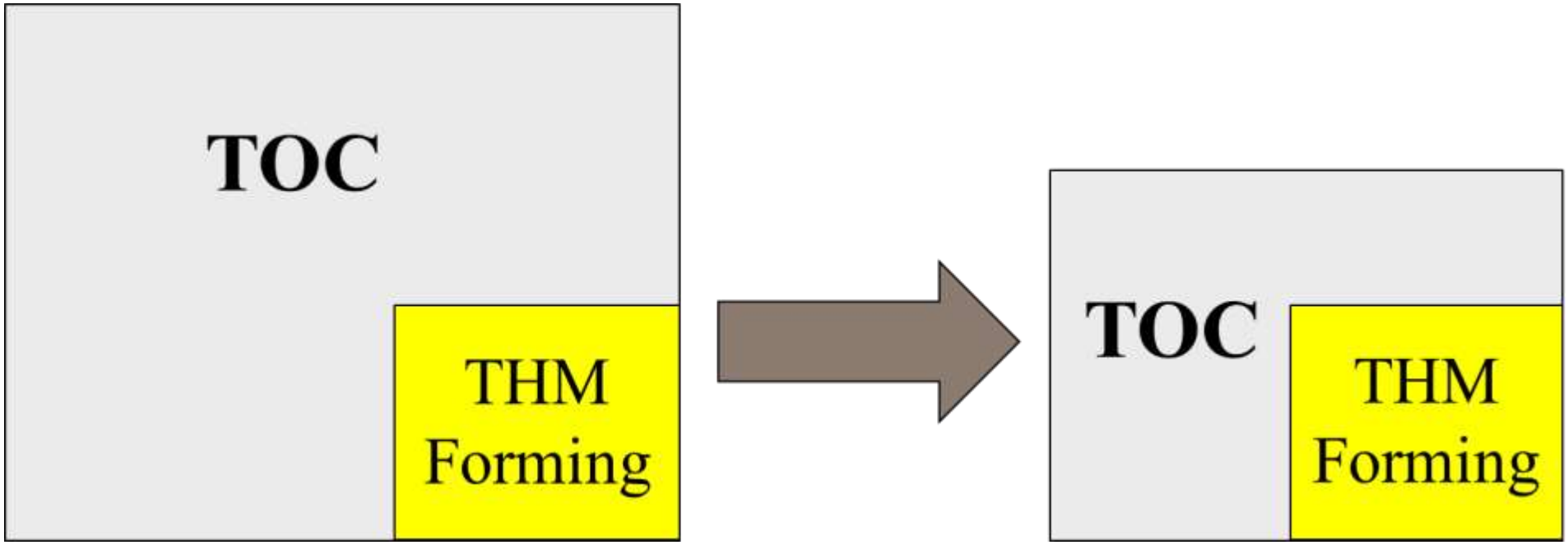




Problem & Opportunity

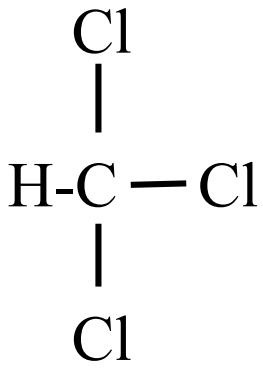
- Trihalomethanes are carcinogenic
- Compounds regulated, regs tightening
- Difficult, ppb analysis
- Expensive
- Other methods can be inaccurate, untimely, expensive
- **Critical process control parameter**

Disinfection Byproducts – A Paradigm Shift

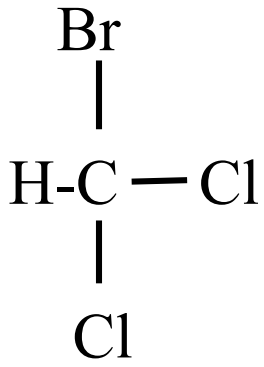


Speciation

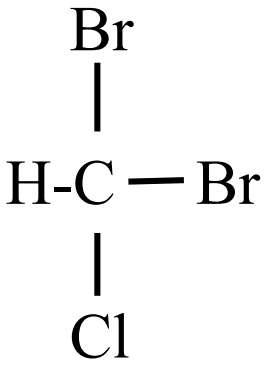
Speciation of THM



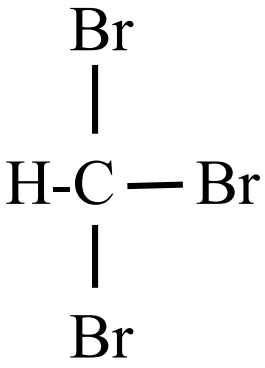
Chloroform



Bromodichloromethane



Dibromochloromethane

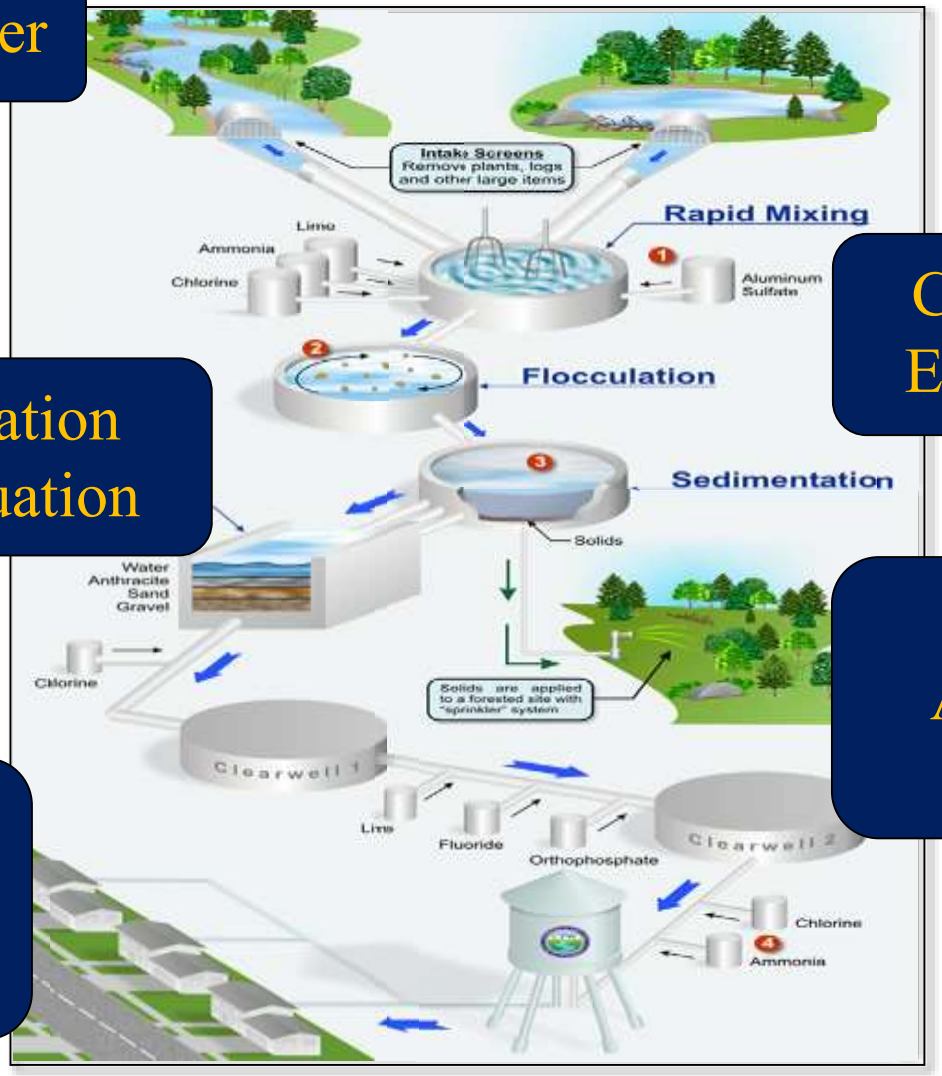


Bromoform

Optimization Opportunities

Optimization Applications

Source Water



Coagulant Evaluation

Filtration Evaluation

GAC Aeration MIEX

Dead Ends Flushing Master Meter

Parker

Case Study I
Complying with Stage II DBPR

Water Plant A Overview

Conventional Surface Water Treatment Plant

Customers – Residential & Whole Sale

300 miles of water mains

Compliance site **THM > 80 ppb**

Water Plant A - Complying Stage II

Available DBP Removal Technologies (2012)

- Chlorine dioxide
- Granular Activated Carbon
- Membrane
- Magnetic Ion Exchange (MIEX) Resin

August, 2012	In-House TTHM Results:	Certified Lab TTHM Results:
Finished water	**23.7**	**23.7**
Site 1	**48.7**	**50.4**
Site 2	**86.6**	**91.0**
Site 3	**67.3**	**72.0**

Redesign of the Water Plant: Require Capital Expenditure

Water Plant A - Complying Stage II

Strategy – Meet Compliance

- Coagulant type and dose
- Strategic allocation of chlorine
- Flushing program

Coagulant type

- Alum
- Aluminum Chlorohydrate (ACH)
- Jar test (UV_{254} & TOC)
- Formation Potential test (THM)

ACH better in removing THM Precursor

Strategic allocation of chlorine & THM measurement

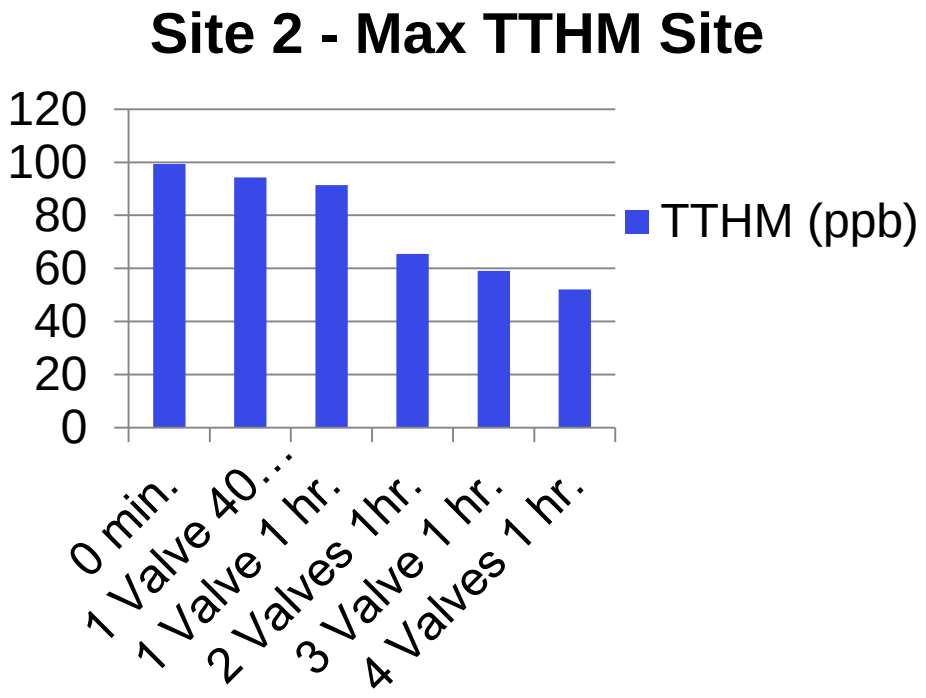
- Subtle increase/decreases in chlorine does affect THM (Applied – Filter and Post-Chlorine dosage)
- Identify coagulant dosage required to remove organics
- Streamlined seasonal THM treatment

Still the worst site THM in quarter 3 > 80 ppb (site 2)

Water Plant A - Complying Stage II

Flushing Strategy:

- Characteristics of Site 2 – Worst Compliance site
- Set up 4 flush valve
- Exercise these valves with variable time
- Measure THM concentration



Conclusion: Changing coagulant, Strategic allocation of chlorine dose, and Flushing program – Helps to comply with Stage II DBPR and save money on flushed water

Case Study II
Capital Upgrade

Water Plant B Overview

Conventional Surface Water Treatment Plant (6 MGD)

Implement Flushing program to reduce THM

Not enough to comply Stage II

Water Plant B – Capital Upgrade

Strategy

Find the proper solution to high THM concentration

Utilize onsite THM to help find the best and most efficient solution

August, 2012	In-House TTHM Results:
Finished water	25.6
Site 1	48.9
Site 2	72.7
Site 3	41.1

Identify alternative treatment option : GAC, Membrane and MIEX

Water Plant B – Capital Upgrade

Started pilot with MIEX
Effluent from MIEX pilot jar tested (Significant decrease in coagulant dose)
THM formation test potential using in house THM testing

Built MIEX plant
Option of treating raw water both MIEX and conventional pathway
Reduce THM significantly

August, 2014	In-House TTHM Results:
Finished water	13.6
Site 1	29.2
Site 2	38.7
Site 3	34.1

In house THM testing justifies investment in MIEX

Case Study III
Reducing Water Loss

Water Plant C Overview

Conventional Water Plant (40 MGD)

Long water mains

Flushing program to reduce water age

Some location need to flush for 7 days before getting a chlorine residual

Water Plant C – Reducing Water Loss

Strategy

Utilize on site THM to help shorten flushing periods

Understand when to start flushing

August, 2014	In-House TTHM Results:
Finished water	15
Site 1	32
Site 2	47
Site 3	56
Site 4	69

Looking for alternative parameter measurement to shorten number of flushing days

Water Plant C – Reducing Water Loss

Difficult to justify to stop flushing based on chlorine residual

Measurement of THM during flushing make more sense

THM concentration reached a stable level after 3 days of flushing

Reduced flushing to 3 days instead of 7 days

August, 2014	In-House TTHM Results:
Finished water	17
Site 1	25
Site 2	37
Site 3	41
Site 4	55

Saved valuable treated water

Case Study IV
Water Age Issues

Water Plant D Overview

Ground Water Plant and Purchased Surface Water Mix (60 MGD)

Large service area with many old connections

Water age ranging from less than one day to over 14 days

Water Plant D – Water Age Issues

Background of Mixing

30 miles away ground water and surface water mix in 2 MG water tank which turns twice a day

THM concentration > 80 ppb

Summer time no issue of THM because high usage of water

Winter time – low usage of water causes THM > 80 ppb

Strategy

Pilot test on GAC – taking water from the 2 MG tank

Measure THM

Shows potential removal of THM (< 9 ppb)

Water Plant D – Water Age Issues

Results

Built 5 GAC reactors near 2 MG tank

Starts operating varying ratio of inlet water mixing between ground and surface water

Ratio prolongs the life of the activated carbon

Reduce rate of carbon changeover from 2 months to 11 months

Plant saves close to $1MM per year in carbon replacement costs

THM Analysis Summary

Paradigm Shift	Every water plant should invest in THM Analysis before investing in THM mitigation technology
Safe Water	Empower personnel to understand and maintain safe drinking water more often
Cost Savings	Utilize tools to optimize controls and save money

Thank You

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