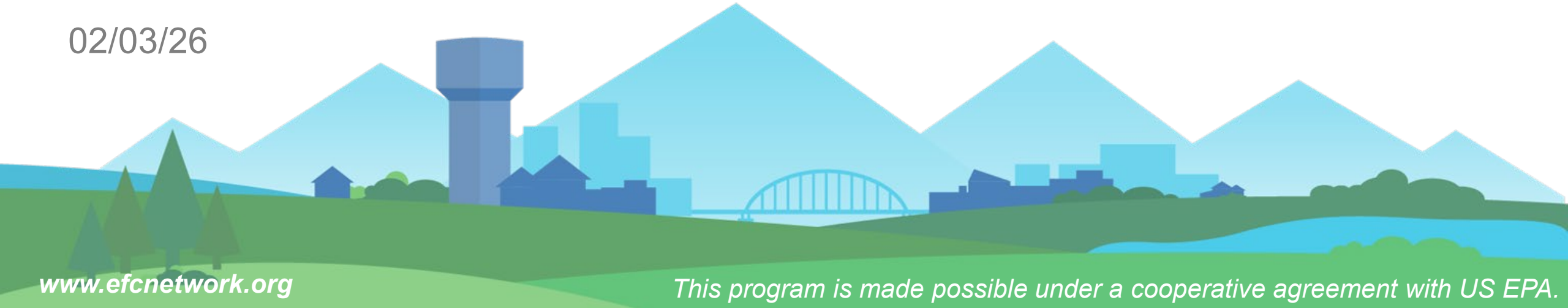
US Territories Wastewater Operator Training Series

Session 15: Disinfection Part 1 - Chlorination, De-chlorination & Safety

02/03/26



This program is made possible under a cooperative agreement with US EPA.

Your trainers for today:

James Markham
Research Engineer

Valeria Cortes-Mora
Professional Intern

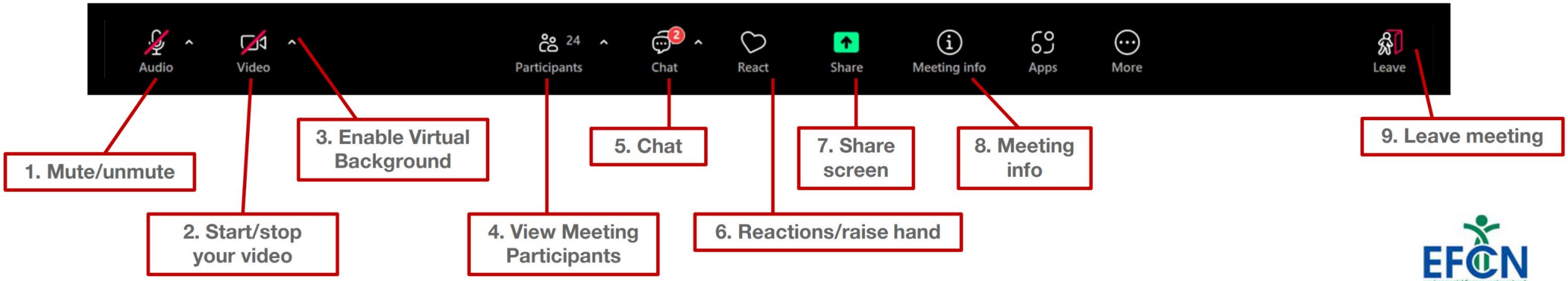
SOUTHWEST
ENVIRONMENTAL
FINANCE CENTER

SCHOOL OF
ENGINEERING

This training series is funded by the EPA

Attendee Meeting Controls

- Locate your control bar
- All attendees will see a black horizontal bar on their screen
- If your control bar is not visible, it may be hidden
  - Move your cursor to the screen's bottom (or top) to reveal this control bar.



WPI/ABC Operator Certification

Standardized Wastewater Treatment Operator Exams

Wastewater Treatment Operator Need-to-Know Criteria

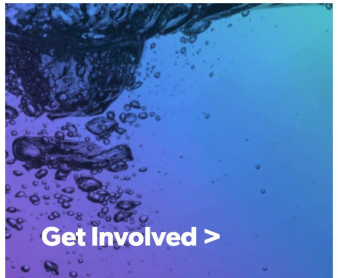
Need-to-Know Criteria outline the content that will be covered on WPI's standardized examinations provided through ABC Testing, a WPI service.

- Wastewater Treatment Operator Class I
- Wastewater Treatment Operator Class II
- Wastewater Treatment Operator Class III
- Wastewater Treatment Operator Class IV

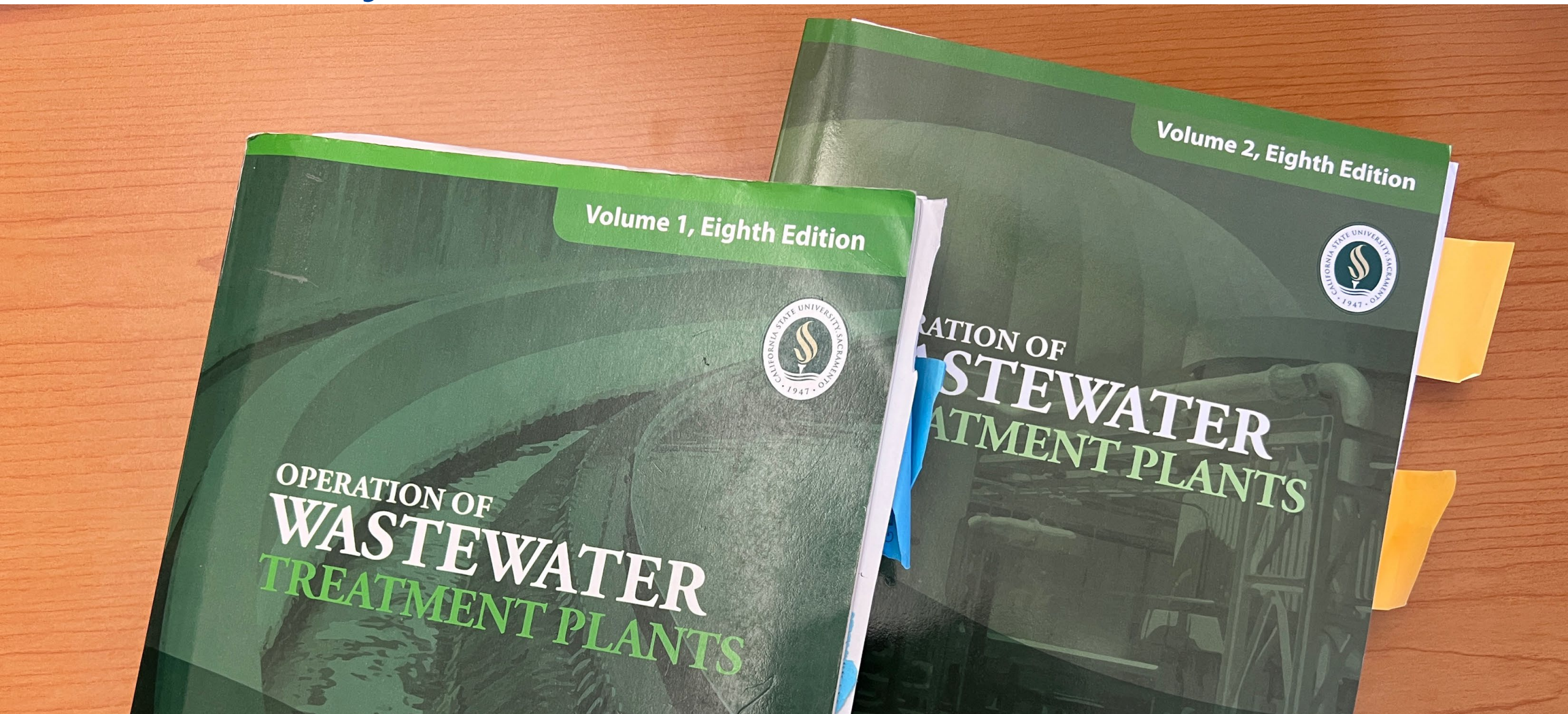
Wastewater Treatment Operator Formula/Conversion Table

WPI standardized exams are administered with a Formula/Conversion Table containing mathematical formulas and common abbreviations that may be present on the exam.

- Wastewater Treatment Operator Formula/Conversion Table



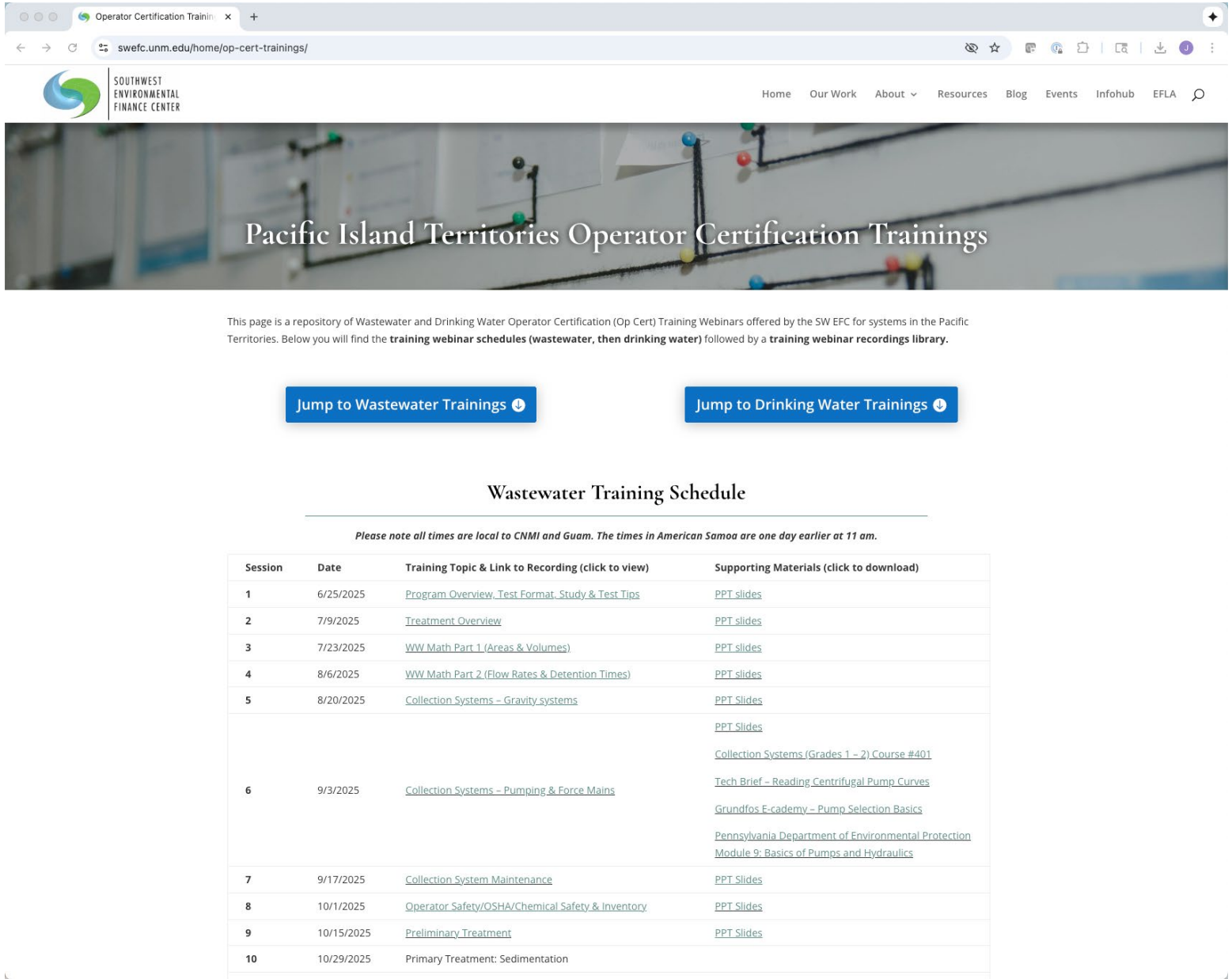
Use all your resources



Schedule for 2025:

Date	Topic
1/20/26	Concept and Math Review Session
2/3/26	Disinfection Part 1 (chlorination/dechlorination) + related math
2/17/26	Disinfection Part 2 - UV and other methods
3/3/26	WW Math Part 3 (Flow, Detention Time)
3/17/26	WW Math Part 4 (BOD Math /Advanced WW Math)
3/31/26	Solids Handling Part 1 (Mechanical Solids Separation)
4/14/26	Solids Handling Part 2 (Solids Handling)
4/28/26	Sampling
5/12/26	Regulations (NPDES Permits and Discharge Limitations)
5/26/26	Treatment System Maintenance
6/9/26	Lab Procedures/Analysis/Interpretation or alternate topic
6/23/26	Using Technology in daily operations (SCADA, Computer, Tablets, CMMS, AI, etc.)
7/7/26	Course Review Session - Short sample exam?

https://swefc.unm.edu/home/op-cert-trainings/



Session	Date	Training Topic & Link to Recording (click to view)	Supporting Materials (click to download)
1	6/25/2025	Program Overview, Test Format, Study & Test Tips	PPT slides
2	7/9/2025	Treatment Overview	PPT slides
3	7/23/2025	WW Math Part 1 (Areas & Volumes)	PPT slides
4	8/6/2025	WW Math Part 2 (Flow Rates & Detention Times)	PPT slides
5	8/20/2025	Collection Systems – Gravity systems	PPT Slides
6	9/3/2025	Collection Systems – Pumping & Force Mains	PPT Slides Collection Systems (Grades 1 – 2) Course #401 Tech Brief – Reading Centrifugal Pump Curves Grundfos E-cademy – Pump Selection Basics Pennsylvania Department of Environmental Protection Module 9: Basics of Pumps and Hydraulics
7	9/17/2025	Collection System Maintenance	PPT Slides
8	10/1/2025	Operator Safety/OSHA/Chemical Safety & Inventory	PPT Slides
9	10/15/2025	Preliminary Treatment	PPT Slides
10	10/29/2025	Primary Treatment: Sedimentation	

Sign in for **every session to** ensure you **get credit** for attending

SOUTHWEST ENVIRONMENTAL FINANCE CENTER

US Territories Water & Wastewater Operator Certification
Virtual Training Series Group Attendance Sheet

Session Title: _____

Session Date: _____

Training Location: _____

Attendee Name	Attendee Signature	Arrival Time	Departure Time

I hereby certify that the individuals listed above attended the referenced training session.

Name: _____

Signature: _____

Title: _____

Date: _____

Please scan this sheet after each training session and email it to swefc@unm.edu with the subject line: "US Territories Op Cert Attendance Sheet"

Overview

- Disinfection overview
- Chemicals used for disinfection
- Factors affecting disinfection
- Dechlorination
- Chlorination and Dechlorination systems
- Safety

Question

1) What form of disinfection do you use?

A) Sodium Hypochlorite (liquid) purchased or self-generated

B) Calcium Hypochlorite (solid)

C) Chlorine Gas

D) UV Disinfection

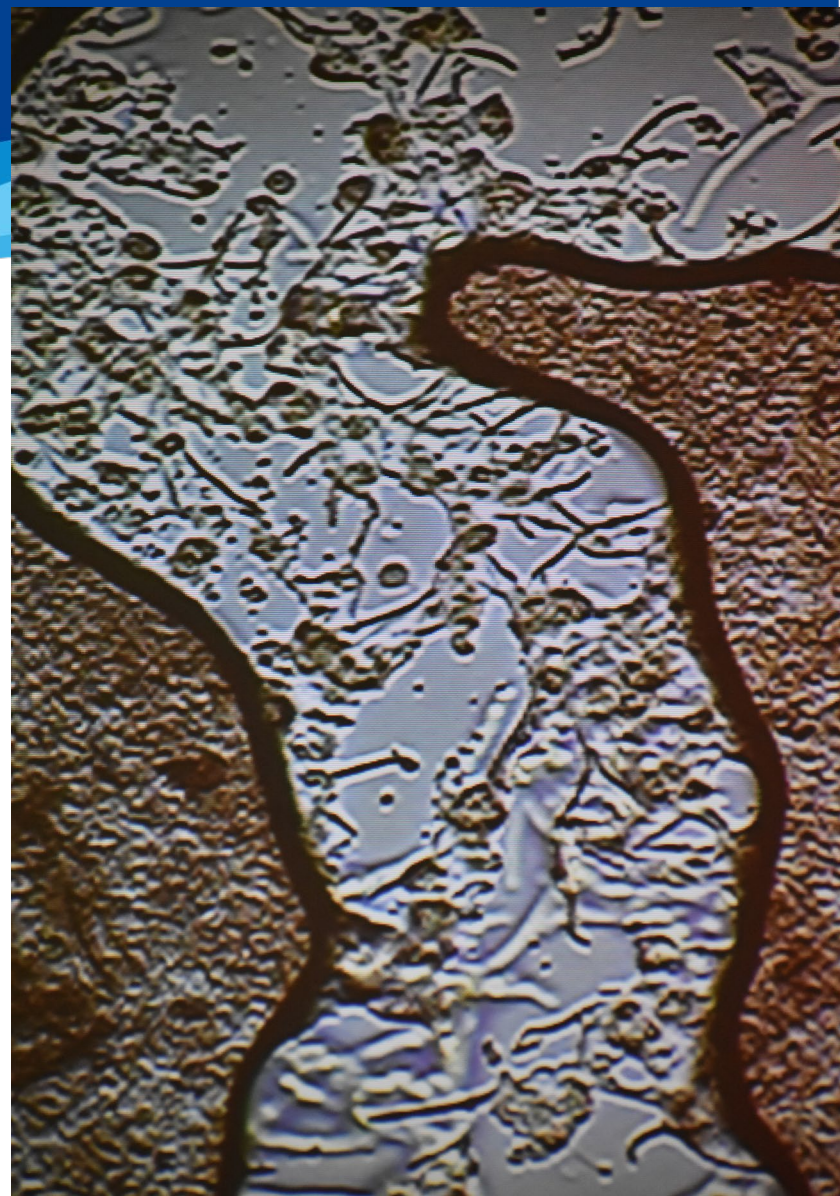
E) Other disinfection method

F) Not sure

Disinfection of Wastewater

What is it?

Disinfection means using a chemical or physical process to inactivate harmful microscopic organisms so they can no longer carry out their cellular processes.



Why Disinfect?

Microscopic organisms can pose a threat to the environment and other humans that may consume that water.

TABLE 1 INFECTIOUS AGENTS POTENTIALLY PRESENT IN UNTREATED DOMESTIC WASTEWATER

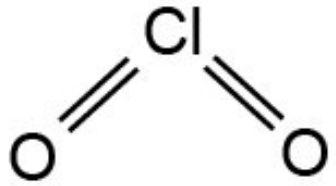
Organism	Disease Caused
Bacteria	
Escherichia coli	Gastroenteritis
Leptospira (spp.)	Leptospirosis
Salmonella typhi	Typhoid fever
Salmonella (=2100 serotypes)	Salmonellosis
Shigella (4 spp.)	Shigellosis (bacillary dysentery)
Vibrio cholerae	Cholera
Protozoa	
Balantidium coli	Balantidiasis
Cryptosporidium parvum	Cryptosporidiosis
Entamoeba histolytica	Amebiasis (amoebic dysentery)
Giardia lamblia	Giardiasis
Helminths	
Ascaris lumbricoides	Ascariasis
Taena solium	Taeniasis
Trichuris trichiura	Trichuriasis
Viruses	
Enteroviruses (72 types) e.g., polio echo and coxsackie viruses	Gastroenteritis, heart anomalies, meningitis
Hepatitis A virus	Infectious hepatitis
Norwalk agent	Gastroenteritis
Rotavirus	Gastroenteritis

Requirement of Clean Water Act of 1972

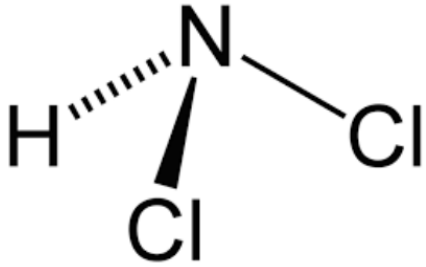
Permits issued by EPA or the State for systems that discharge into surface waters

Chemicals Used For Disinfection

Chlorine

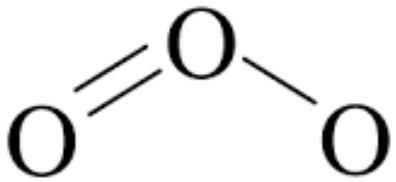


Chlorine Dioxide



Chloramines

Bromine



Ozone

3 Types of Chlorine

Chlorine Gas (Cl_2) – 100% chlorine

- Can be compressed into a liquid form
- Most hazardous form of chlorine

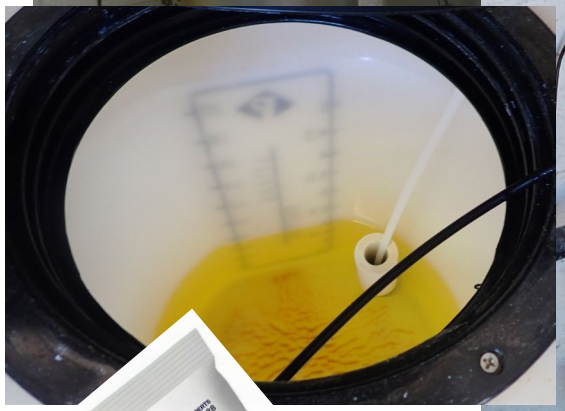
Sodium Hypochlorite – NaOCl (liquid)

- 10–12.5% chlorine; mixed by manufacturer
- Household bleach is 4.75-8.25%
- Shelf life of 1-3 months (dependent on storage conditions)

Calcium Hypochlorite – CaOCl (solid, HTH)

- Up to 67% chlorine
- 1%-3% solution mixed by operator
- Shelf life of 1 year
- More safety issues than NaOCl

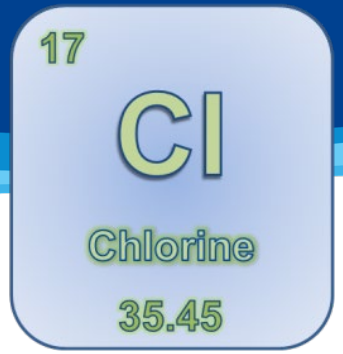
1% = 10,000 mg/L Cl_2



Sodium Hypochlorite generated on-site

$NaCl + H_2O + energy = NaOCl + H_2$

Creates weaker strength NaOCl than what is purchased (0.4 - 0.8 ppm)



Why use Chlorine?

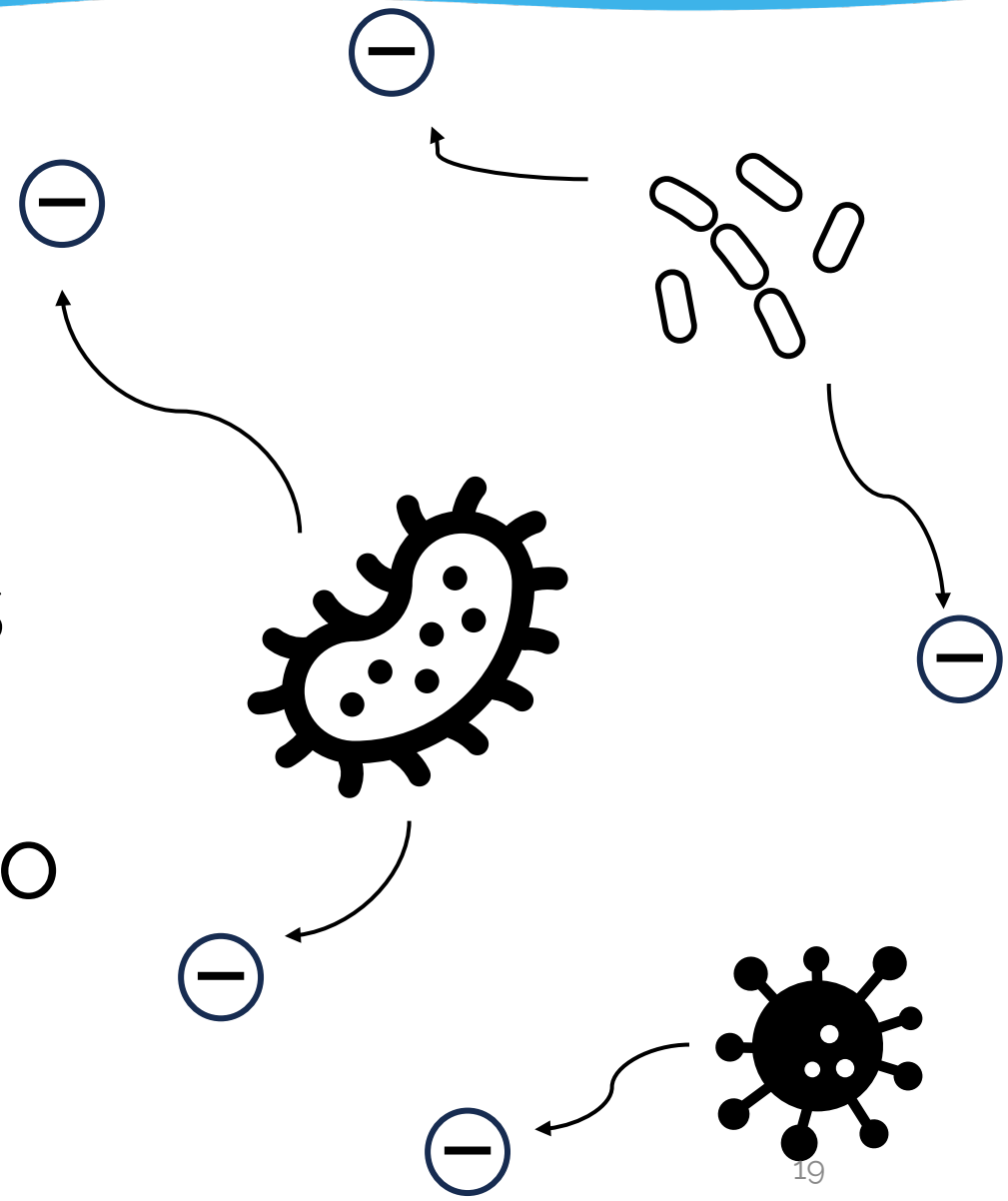
- High germicidal power – inactivates a high proportion of microorganisms at low dosages
- Highly soluble in water
- Costs less than most other methods
- Typically, readily available
- Remaining residual can be measured to evaluate effectiveness

Disadvantages

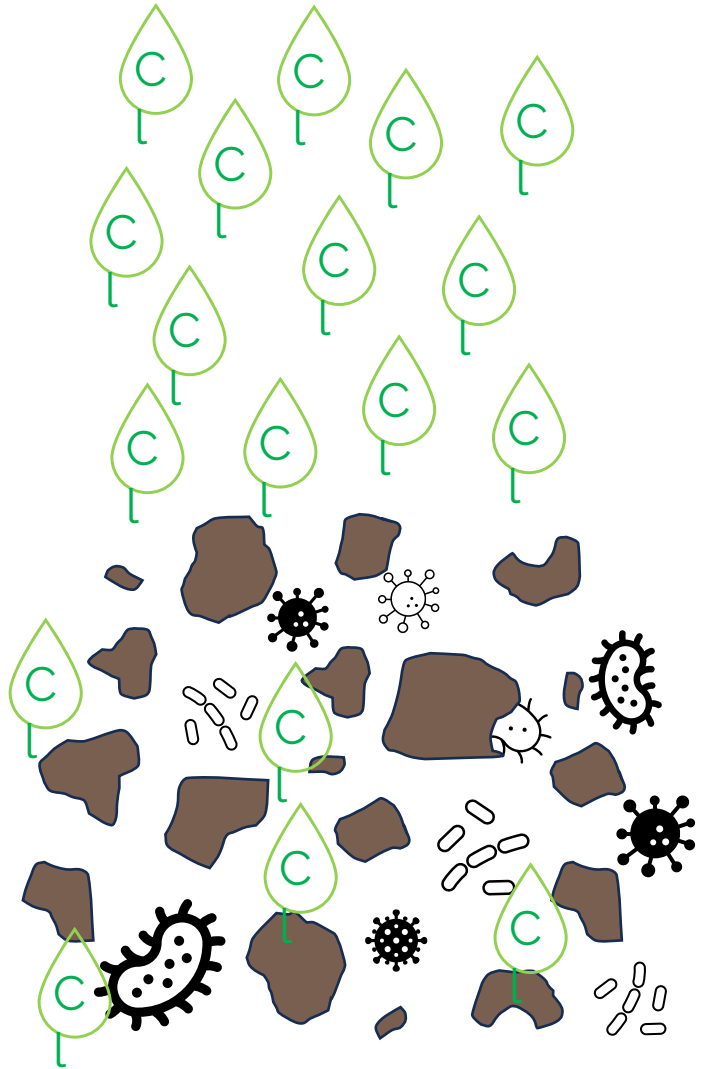
- Toxic to aquatic life
- Requires dechlorination
- Reacts to form toxic disinfection byproducts (TTHM, HAA5)
- Significant amount may be required if BOD is high

Chemical Disinfection Process

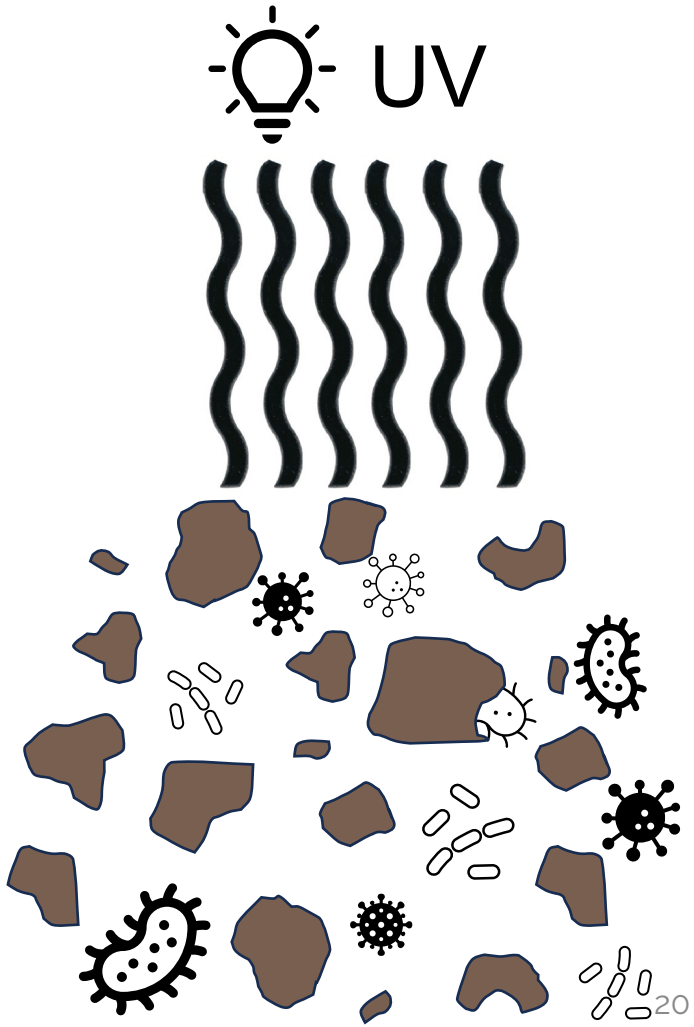
Oxidation – the oxidant steals electrons from the virus or cell's enzymes so the it can no longer perform metabolic functions



Factors that affect disinfection



Suspended Solids (TSS) and Biological Oxygen Demand (BOD)



Factors that affect disinfection

Disinfection must take place after primary treatment

Factors that affect disinfection

pH

Two reactions when chlorine meets water

Cl_2 = Chlorine

H_2O = Water

HOCl = Hypochlorous Acid

HCl = Hydrochloric Acid

H^+ = hydrogen ion

OCl^- = hypochlorite ion

$$Cl_2 + H_2O = \mathbf{HOCl} + HCl$$

$$\mathbf{HOCl} = H^+ + OCl^-$$

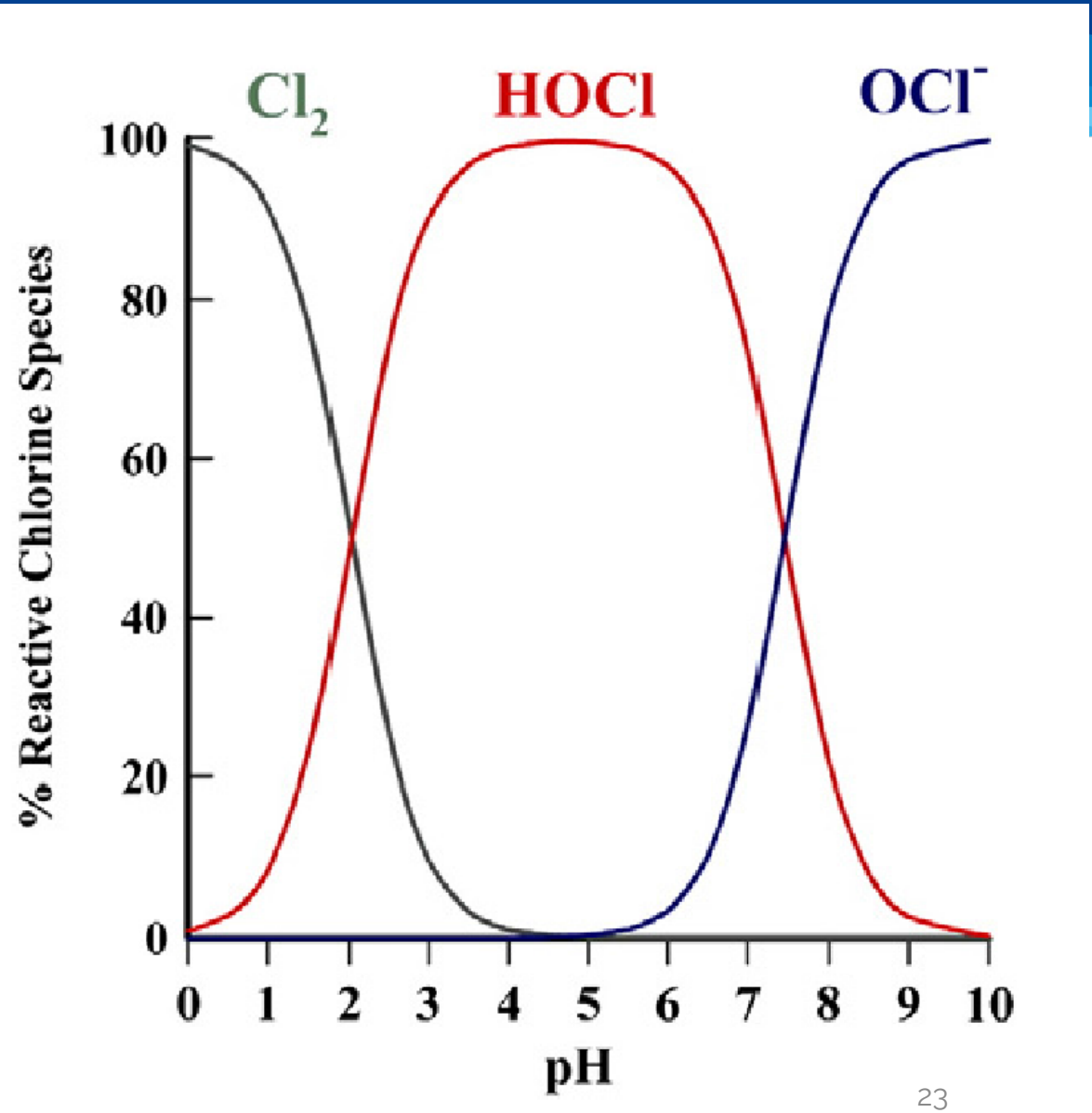
HOCl is more effective as a disinfectant than OCl^- (100-300 times greater)

Factors that affect disinfection

pH

$Cl_2 + H_2O = HOCl + HCl$

$HOCl = H^+ + OCl^-$



Question

2) Which situation has the most effective disinfection?

A) Low TSS, low pH, more HOCl (hypochlorous acid) than OCl^- (hypochlorite ion)
B) High TSS, low pH, more HOCl (hypochlorous acid) than OCl^- (hypochlorite ion)
C) Low TSS, high pH, more OCl^- (hypochlorite ion) than HOCl (hypochlorous acid)
D) High TSS, high pH, more OCl^- (hypochlorite ion) than HOCl (hypochlorous acid)

Factors that affect disinfection

If **Nitrogen** compounds are present in the water, then HOCl will combine with them to form **Chloramines**

Nitrogen compounds may include:

- Inorganic ammonia (NH_3)
- Organic proteins and amino acids

Chloramines are *Combined Residual Chlorine*

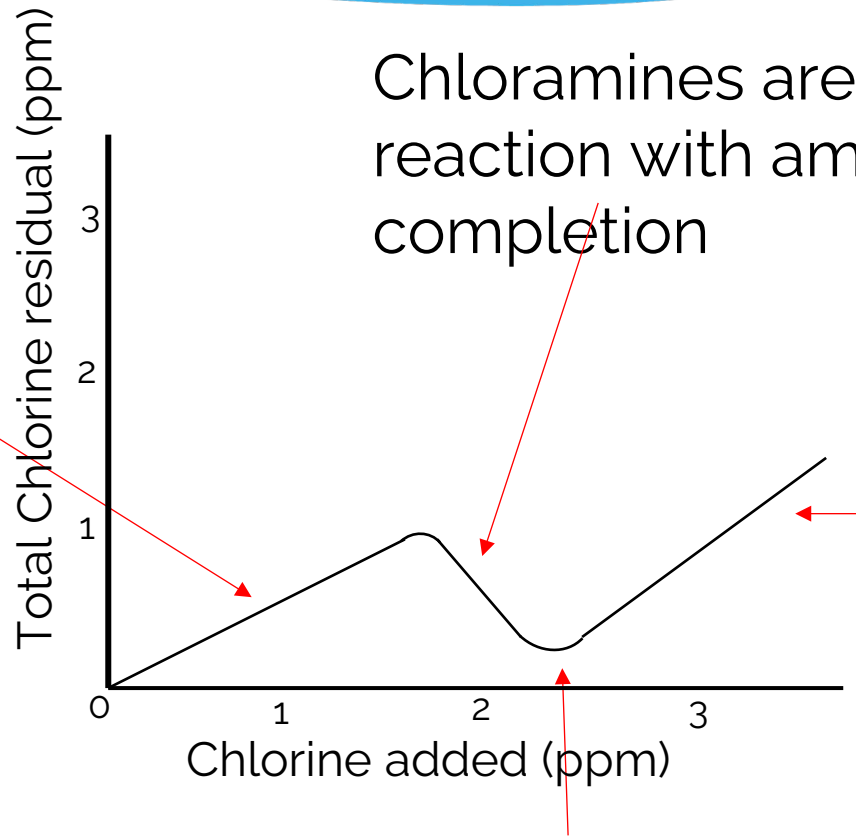
Combined chlorine is available for disinfection, BUT

Less effective as a disinfectant

Doesn't degrade in the system as quickly

Breakpoint Chlorination

Chloramines are being formed (combined chlorine residual)



Chloramines are being “destroyed”, reaction with ammonium nearing completion

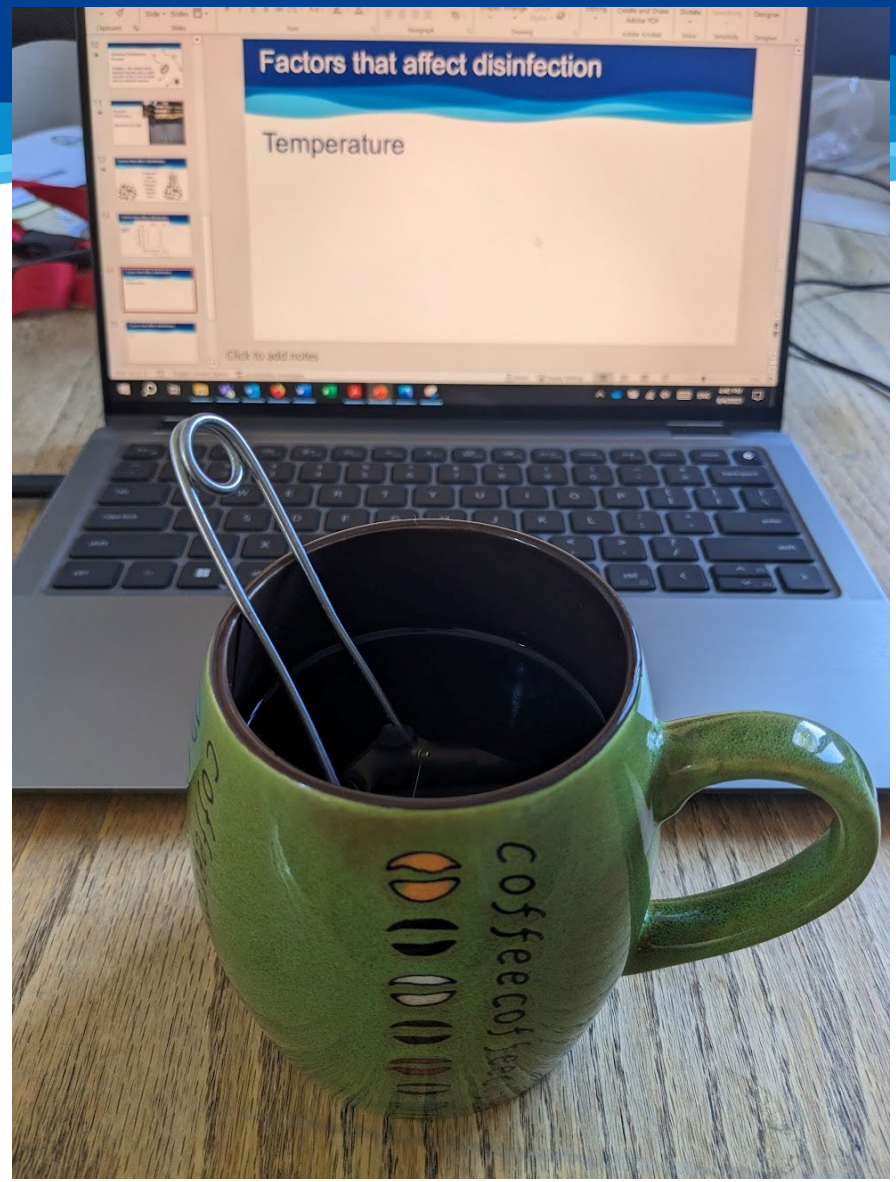
Free chlorine residual increasing

Breakpoint – all the ammonium has been used up in the reaction

Factors that affect disinfection

Temperature

The higher the temperature the quicker the chlorine reacts to organisms and particles in the water.



Factors that affect disinfection

CT = Concentration x Time

Chlorine takes time to interact with and inactivate organisms. CT must be met to ensure affective inactivation.

- The higher the concentration the less time needed.
- The more time available the lower the required concentration.

Question

3) Which factor does not affect disinfection?

A) Amount of stuff in the water
B) Quantity of H^+ ions in water
C) Chlorine dosage
D) Operator certification level


Is your water ready to be discharged into the environment?
Not if you used chlorin e

Dechlorination -

The process of removing chlorine residual from water before it is returned to the environment

Why dechlorinate?

- Chlorine residual is toxic to aquatic life
- Chlorine combines with organic matter to create chlorinated compounds that are carcinogens and toxic to aquatic life and human consumption

Dechlorination Options

- **Detention** - Long detention times allow chlorine to dissipate
- **Aeration** - Bubbling air through the effluent in the last part of a long chlorine contact basin
- **Sunlight** – Requires effluent to be spread into shallow layer and exposed to sunlight
- **Activated Carbon** – chlorine will adsorb on activated carbon
- **Chemical Reactions -**
  - Sulfur dioxide (SO_2) is used because it reacts instantaneously with chlorine on an approximately one-to-one ratio (1 mg/L of SO2 will remove approximately 1 mg/L of chlorine residual)
  - Other chemicals are also used

Dechlorination Process (converting free chlorine into harmless chloride)

Addition of chemicals:

- Sulfur dioxide (SO_2)
- Sodium sulfite (Na_2SO_3)
- Sodium metabisulfite ($Na_2S_2O_5$)
- Sodium bisulfite ($NaHSO_3$)
- Sodium thiosulfate ($Na_2S_2O_3$)
- Calcium thiosulfate (CaS_2O_3)
- Others…

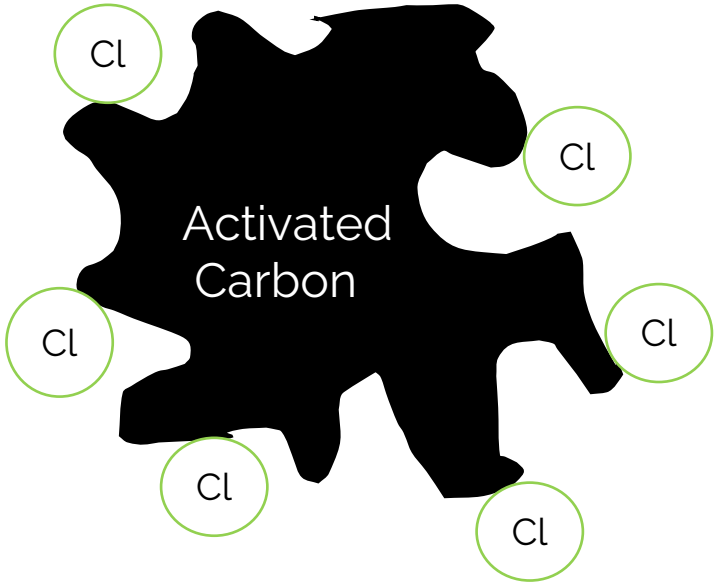
Note: Sulfur dioxide is hazardous

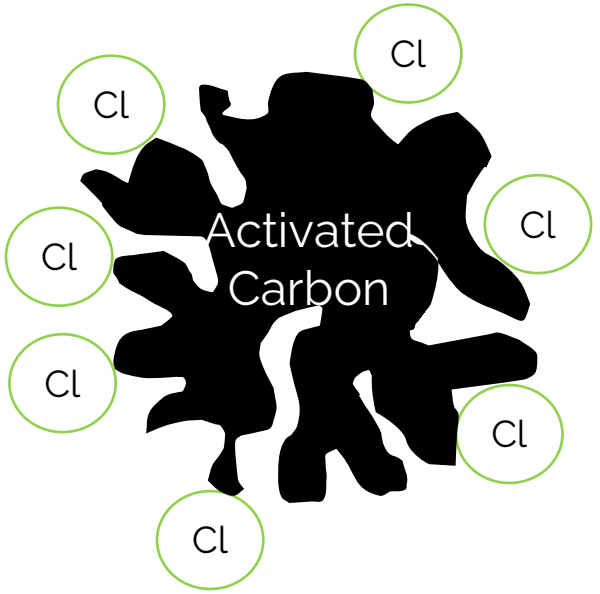
- It is a colorless gas that has a pungent odor and can hurt or kill you
- Don't handle it unless trained and authorized
- Precautions are similar to those for chlorine
- NEVER work alone with it

Dechlorination Process

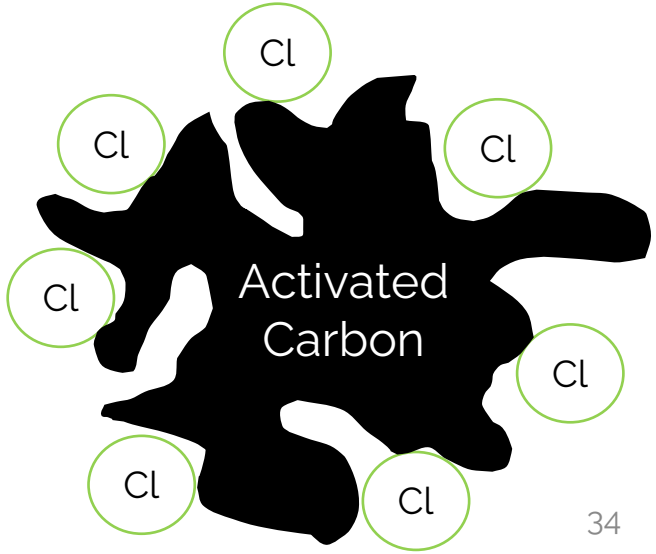
Carbon Adsorption

Same activated carbon filter used to remove taste and odor, organic compounds, and more from drinking water.





Higher cost than sulfonation due to needing to replace Powered Activated Carbon (PAC) or Granular Activated Carbon (GAC)



Question

4) What do you use for dechlorination?

A) Sulfur Dioxide
B) Sodium Sulfite, Metasulfite, Bisulfite, or Thiosulfite
C) Calcium Thiosulfate or similar
D) Carbon adsorption
E) We don't dechlorinate or N/A

Question

5) Why dechlorinate prior to discharge?

A) Undesirable smell of chlorine
B) Requirement of discharge permit
C) Chlorine is harmful to environment
D) B and C

Question

6) Which of these will not work for dechlorination?

A) Sodium Thiosulfate
B) Caustic soda (sodium hydroxide)
C) Sulfur Dioxide
D) Powder Activated Carbon (PAC)

Safety

Univar
3075 Highland Pkwy STE 200
Downers Grove, IL 60515
425-889-3400

SAFETY DATA SHEET

1. Identification

Product identifier: SODIUM HYPOCHLORITE 10-16%

Other means of identification

Synonyms	Liquichlor, Bleach
CAS NUMBERS:	7681-52-9
SDS number:	000100001054

Recommended use and restriction on use

Recommended use: Reserved for industrial and professional use.

Restrictions on use: Not known.

Emergency telephone number:For emergency assistance Involving chemicals

call CHEMTREC day or night at: 1-800-424-9300. CHEMTREC INTERNATIONAL Tel# 703-527-3887

2. Hazard(s) identification

Hazard classification

Physical hazards

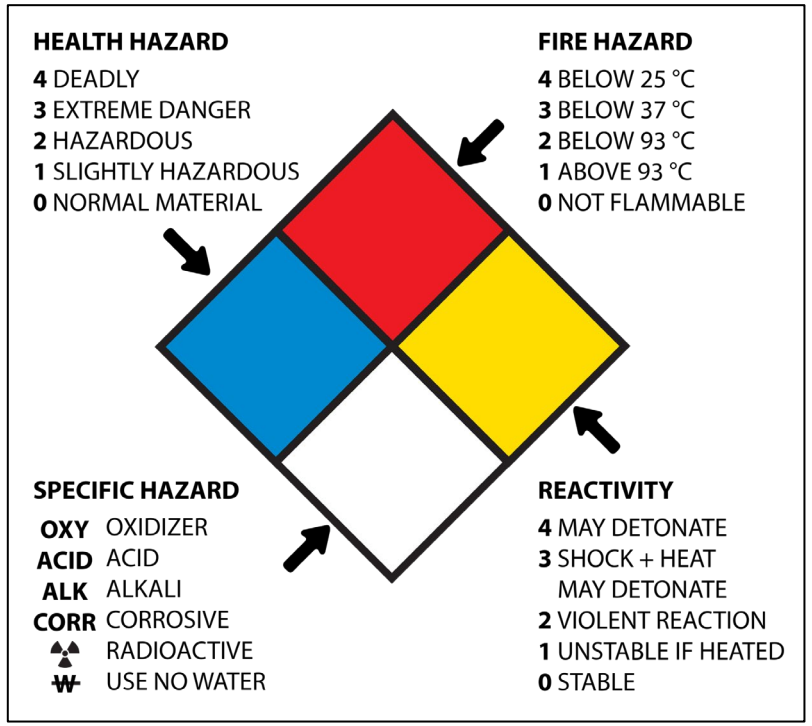
Corrosive to metals	Category 1

Health hazards

Acute toxicity (Oral)	Category 4
Skin corrosion/irritation	Category 1
Serious eye damage/eye irritation	Category 1
Environmental hazardsAcute hazards to the aquatic environment	Category 1

Label elements

Hazard symbol



OSHA® QUICK CARD™

Hazard Communication Standard Pictogram

The Hazard Communication Standard (HCS) requires pictograms on labels to alert users of the chemical hazards to which they may be exposed. Each pictogram consists of a symbol on a white background framed within a red border and represents a distinct hazard(s). The pictogram on the label is determined by the chemical hazard classification.

HCS Pictograms and Hazards

Health Hazard	Flame	Exclamation Mark
• Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	• Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides	• Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non-Mandatory)
Gas Cylinder	**Corrosion**	**Exploding Bomb**
• Gases Under Pressure	• Skin Corrosion/ Burns • Eye Damage • Corrosive to Metals	• Explosives • Self-Reactives • Organic Peroxides
Flame Over Circle	**Environment** (Non-Mandatory)	**Skull and Crossbones**
• Oxidizers	• Aquatic Toxicity	• Acute Toxicity (fatal or toxic)

For more information:

U.S. Department of Labor

OSHA® Occupational Safety and Health Administration

www.osha.gov (800) 321-OSHA (6742)

OSHA 3491-01R 2016

Gas Chlorine

100%

- Greenish-yellow gas
- 2.5 times heavier than air
- Turns into hydrochloric acid when it comes into contact with moisture
- Decreases the pH of the water it is added to
- Does not support combustion
- Comes in cylinders of 100 or 150 pounds; 1 ton; or rail cars from 16 to 90 tons
- Filled as liquid 85% full; turns to gas at room temperature

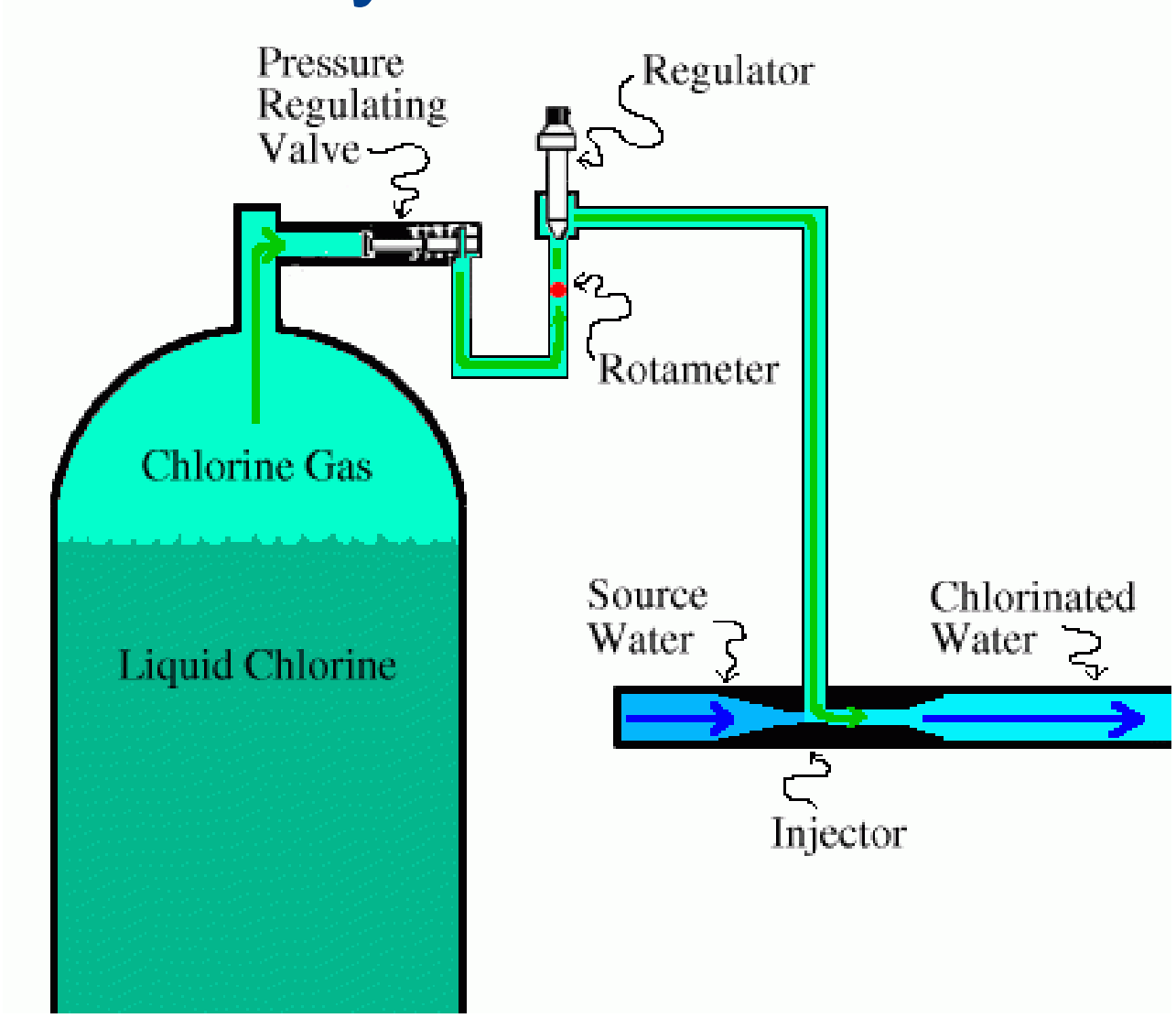
Gas Chlorine

CHLORINE EXPOSURE SYMTOMS:

- Blurred vision and watery eyes
- Burning sensation in the nose, throat, and eyes
- Coughing
- Chest tightness
- Difficulty breathing or shortness of breath. Fluid in the lungs (pulmonary edema) that may be delayed for a few hours
- Nausea and vomiting

https://emergency.cdc.gov/agent/chlorine/basics/facts.asp

Gas Chlorination System



Gas Chlorination System

Chlorine Cylinder Scale

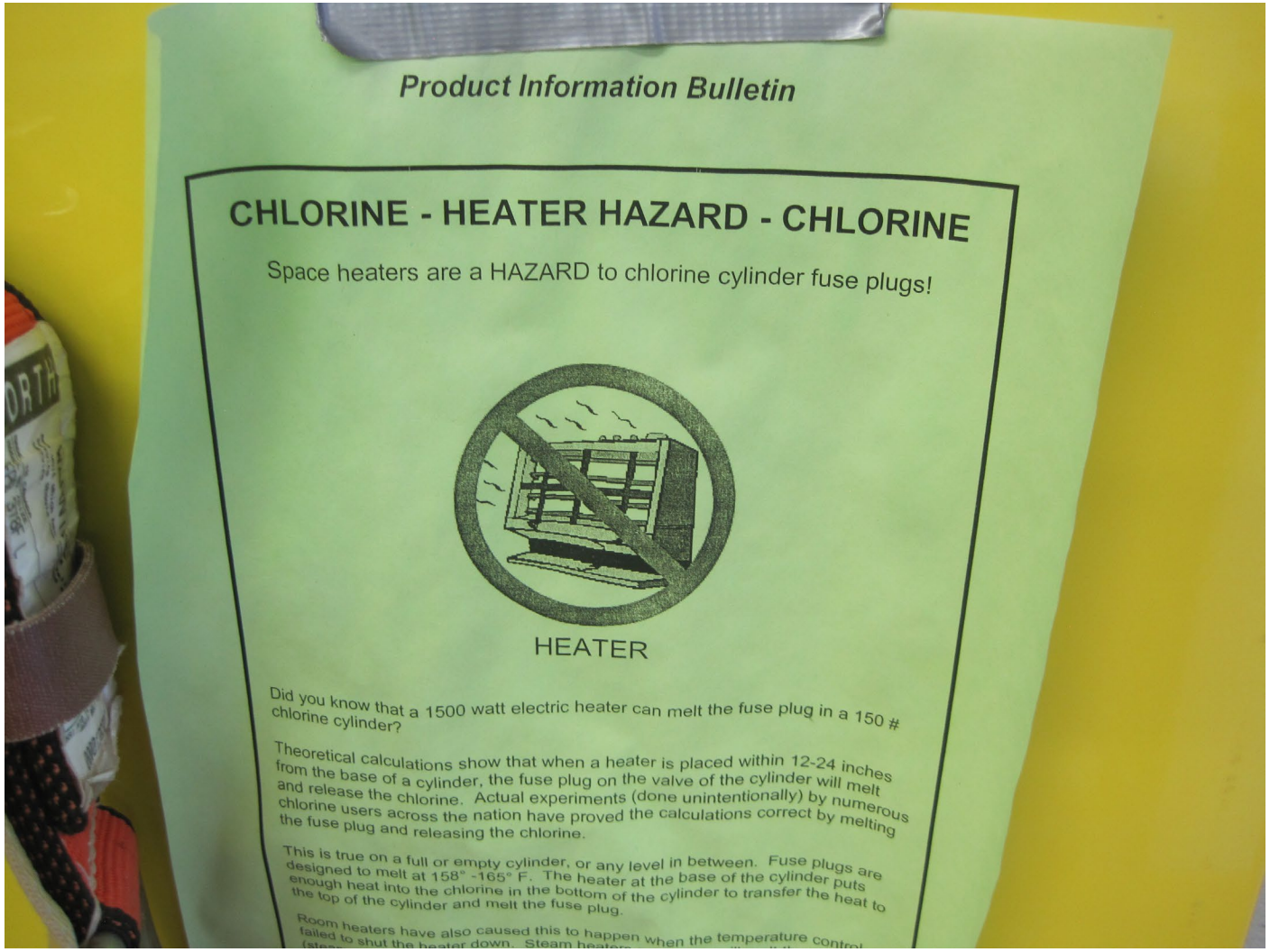

CHLORINE EJECTOR

Gas Chlorination System

Gas Chlorine Cylinder Fusible Plug

- Fusible plug melts or softens around 157° F and releases the gas to prevent build up of excessive pressures and possibility of catastrophic rupture due to fire or high temperatures
- 100 lb and 150 lb cylinders have one plug, ton cylinders have 6 plugs

Fusible Plugs & Space Heaters



Product Information Bulletin

CHLORINE - HEATER HAZARD - CHLORINE

Space heaters are a HAZARD to chlorine cylinder fuse plugs!

HEATER

Did you know that a 1500 watt electric heater can melt the fuse plug in a 150 # chlorine cylinder?

Theoretical calculations show that when a heater is placed within 12-24 inches from the base of a cylinder, the fuse plug on the valve of the cylinder will melt and release the chlorine. Actual experiments (done unintentionally) by numerous chlorine users across the nation have proved the calculations correct by melting the fuse plug and releasing the chlorine.

This is true on a full or empty cylinder, or any level in between. Fuse plugs are designed to melt at 158° -165° F. The heater at the base of the cylinder puts enough heat into the chlorine in the bottom of the cylinder to transfer the heat to the top of the cylinder and melt the fuse plug.

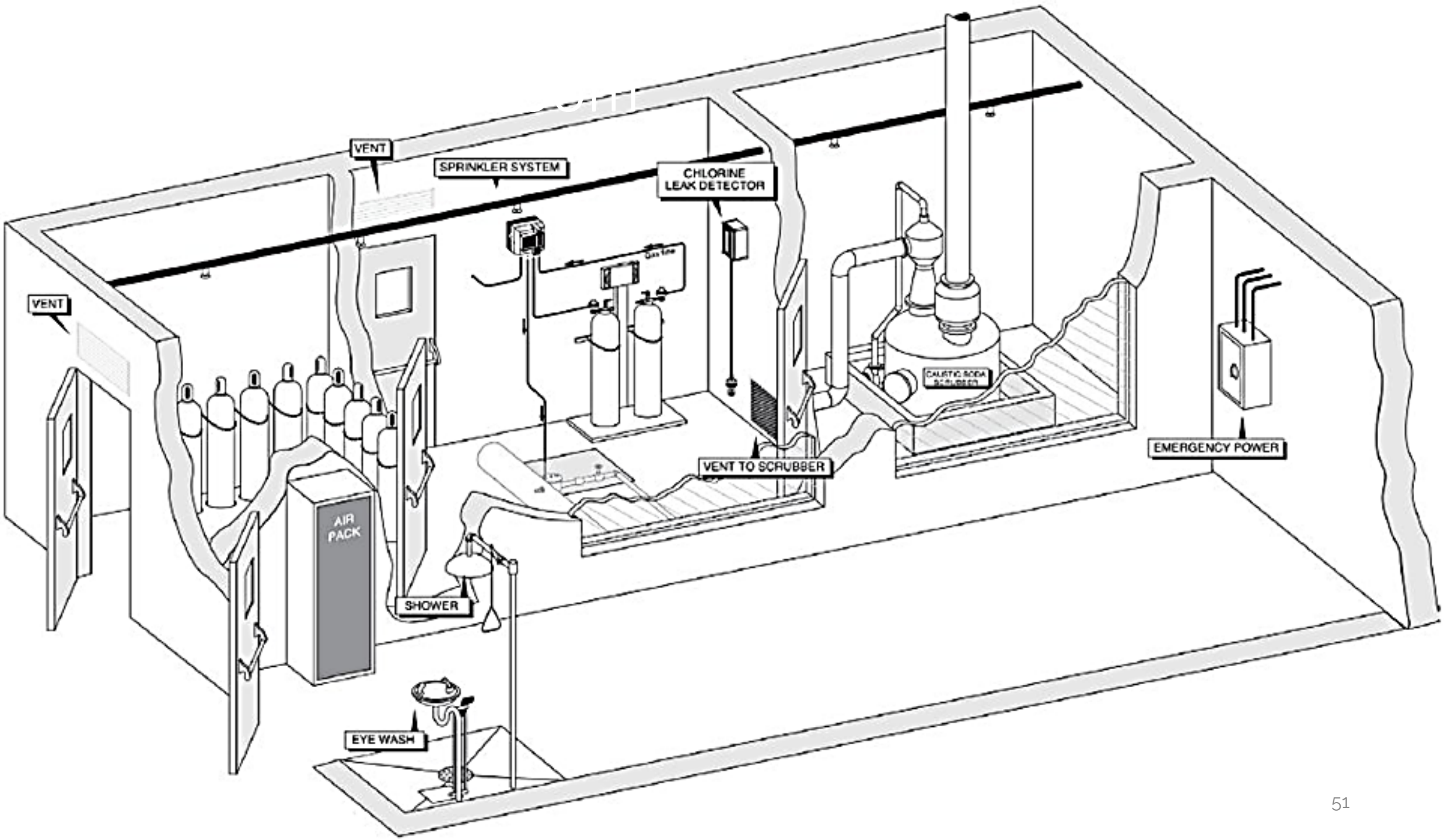
Room heaters have also caused this to happen when the temperature control failed to shut the heater down. Steam heaters

Gas Chlorine Storage

Chlorine Gas Room Ventilation

- Light switch and vent switch chlorine room
- Fresh air from the ceiling or high up discharged air within 12 inches of the floor
- If chlorine leak occurs, must be able to direct the chlorine containing air to a treatment system

Chlorine Vapor Scrubber


VENT
SPRINKLER SYSTEM
CHLORINE LEAK DETECTOR
VENT
CAUSTIC SODA SCRUBBER
VENT TO SCRUBBER
EMERGENCY POWER
AIR PACK
SHOWER
EYE WASH

Chlorine Gas Safety

- Have a team trained to deal with leaks using proper equipment and procedures
- Must have SCBAs located near the door outside the chlorination room
- Treatment system for chlorine containing air
- Alarm system
- Standby source of power required for chlorine ventilation, detection system, alarm, and air treatment system

Chlorine Gas Safety

- Checking for **SMALL** leaks with ammonia solution
  - 28% to 30% ammonia solution in a squeeze bottle or with a rag or paint brush (**NOT** a spray bottle)
  - If chlorine is present white fumes will form.
- If a leak is detected immediately turn off chlorine valve
- Find leak and repair – equipment MUST be taken out of service to repair it
- When taking a gas chlorinator out of service the operator should shut the chlorine supply off at the tank and then evacuate the lines **before** turning off the water.

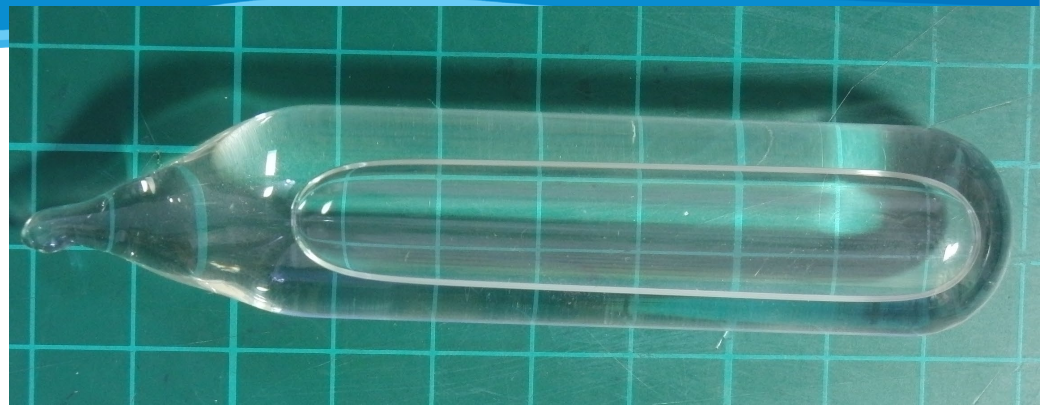
Chlorine Gas Safety

- Limit exposure – only authorized and trained personnel
- Post clear, visible warning signs

Gas Chlorine

- 0.2 ppm – NOTICABLE ODOR
- 15 ppm – IRRITATION AFTER A MINUTES
- 30 ppm – IMMEDIATE COUGHING
- 40 ppm – DANGEROUS AFTER A FEW MINUTES
- 1000 ppm – LETHAL IN MINUTES
- Between 2001 and 2011, 14 Americans died from on-the-job chlorine exposure.
  https://www.msdsonline.com/2015/02/27/fatal-accident-in-ca-even-small-quantities-of-chlorine-pose-danger/

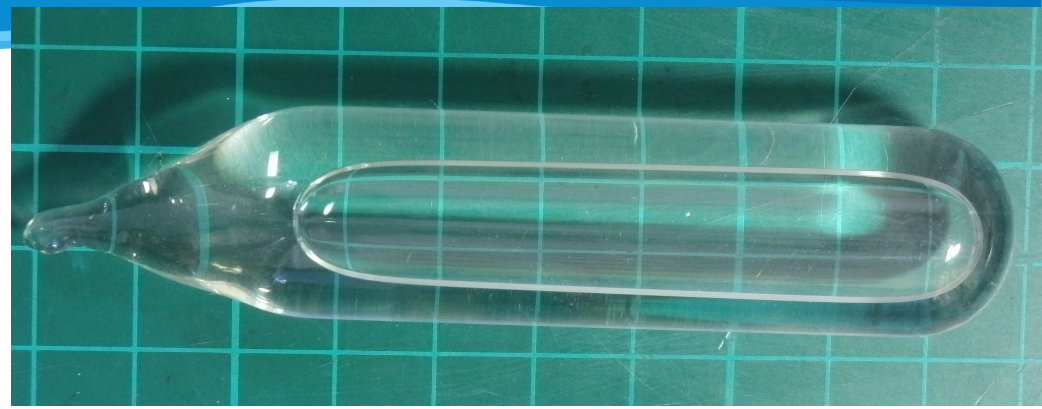
Sulfur Dioxide Gas



Sulfur dioxide gas is hazardous

- It is a colorless gas that has a pungent odor and can kill you
- It's heavier than air (like chlorine)
- It forms acid in the presence of moisture (think eyes, nose, lungs)
- Don't handle it unless trained and authorized
- Precautions are similar to those for chlorine
- NEVER work alone with it

Sulfur Dioxide Gas



- 3-5 ppm – NOTICABLE ODOR
- 8-12 ppm – IRRITATION AFTER A MINUTES
- 20 ppm – IMMEDIATE EYE IRRITATION AND COUGHING
- 10 ppm – MAXIMUM ALLOWABLE FOR 8 HOUR EXPOSURE
- 50-100 ppm – MAXIMIUM ALLOWABLE FOR 1 HOUR EXPOSURE
- 400-500 ppm – IMMEDIATELY DANGEROUS CONENTRATION

- There are documented cases of fatalities caused by SO_2 exposure

Question

7) You have a major chlorine release while you're in the room. What is your first action?

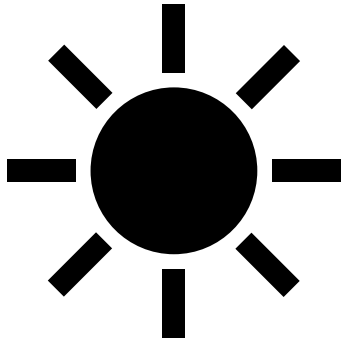
A) Crawl to the door and exit
B) Keep your head high and go to the exit
C) Turn off the valve with the wrench
D) Call the fire department

Hypochlorites (Sodium, Calcium)

- Corrosive
- NOT flammable
- May react explosively with many common substances or form explosive compounds
  - Ammonia, amines, charcoal, organic sulfides, acids
  - Organics (oil, brake fluid, gas, pesticides)
  - Releases chlorine gas or chloramines
- Odor may not provide an adequate warning of hazardous concentrations
- Toxic by mouth or skin exposure

Storing Sodium Hypochlorite

- Ideal storage temperature: 60°F (15.5°C)
- Away from acids, ammonia
- In well-fitted air-tight bottles/drums
- Away from sunlight



Calcium Hypochlorite

- White powder/ granules/tablets
- Eyes, nose, lung, skin irritant
- Extremely corrosive when wet
- Explosive at >100°F

Mixing Calcium Hypochlorite

- Mix only with water using corrosion resistant materials
- Minimize dust
- No eating, drinking, smoking or chewing gum when handling chlorine in any form
- Use personal protective equipment (PPE)
- If the solution or dry chemical spills on skin, immediately flush with a large amount of water
- Place the powder into the water (not the other way around), otherwise there's a possibility of an explosion

Storing Calcium Hypochlorite

- Keep cool and dry
- Label in original containers (Date Received, Date Opened)
- Store away from organic chemicals (can react with and cause an explosion and/or a fire)
  - Grease,
  - Oil,
  - Pesticides

Dechlor Safety

https://www.mysafetylabels.com/chemical-label/sulfur-dioxide-nfpa-label/sku-lb-1591-110

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date 20-Jan-2010 **Revision Date** 24-Dec-2021 **Revision Number** 4

1. Identification

Product Name Sodium sulfite

Cat No. : AC219270000; AC219270010; AC219270050; AC219272500

CAS No 7757-83-7
Synonyms Sulfurous acid, disodium salt.

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company
Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number For information **US** call: 001-800-ACROS-01 / **Europe**
Emergency Number **US:**001-201-796-7100 / **Europe:**
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**

2. Hazard(s) identification

Classification
Classification under 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Stand

Label Elements
None required

Hazards not otherwise classified (HNOC)
None identified

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Sodium sulfite **Revision Date** 24-Dec-2021

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Sodium sulfite	7757-83-7	>95

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Get medical attention immediately if symptoms occur.

Inhalation Remove to fresh air. Get medical attention immediately if symptoms occur.

Ingestion Clean mouth with water and drink afterwards plenty of water. Get medical attention if symptoms occur.

Most important symptoms and effects None reasonably foreseeable.
Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Water spray, carbon dioxide (CO2), dry chemical, alcohol-resistant foam.

Unsuitable Extinguishing Media No information available

Flash Point No information available
Method - No information available

Autoignition Temperature No information available
Explosion Limits
Upper No data available
Lower No data available
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes.

Hazardous Combustion Products
Sulfur oxides. Sodium oxides.
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
1	0	1	N/A

6. Accidental release measures

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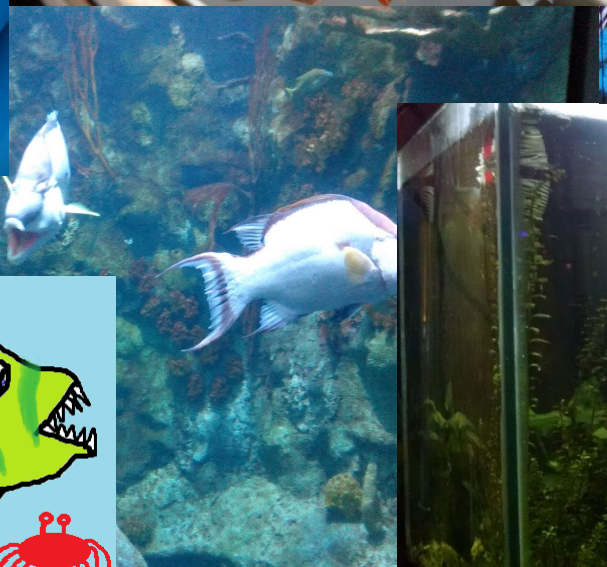
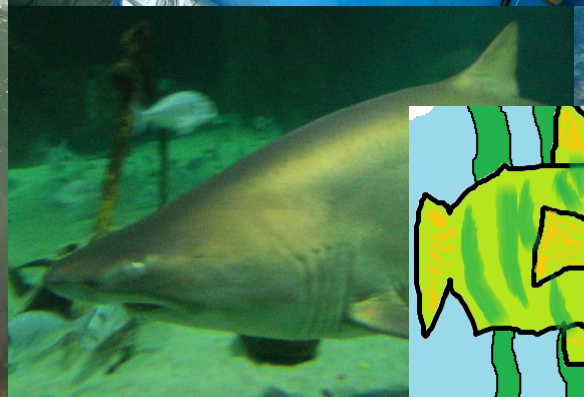
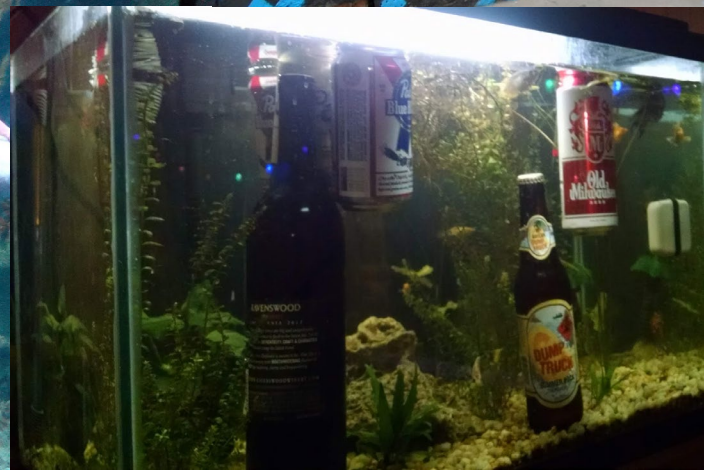
NFPA

Health	Flammability	Instability	Physical hazards
1	0	1	N/A

Thank you for attending and for protecting aquatic life and water for downstream consumption!








Questions?

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