1/2-Day Water Operations Overview for VSS/D1/T1 Certified Drinking Water Operators

October 29, 2026

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Resources: Access presentation materials, handouts, and links shared during the webinar

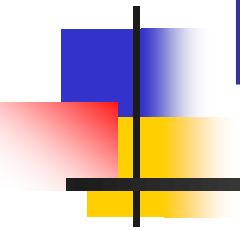


TCH Requirements

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2. Participate in at least 80% of polls
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TCH certificates will be emailed within two (2) weeks to eligible participants.



Disinfection

Pre-certification Training

Tap water

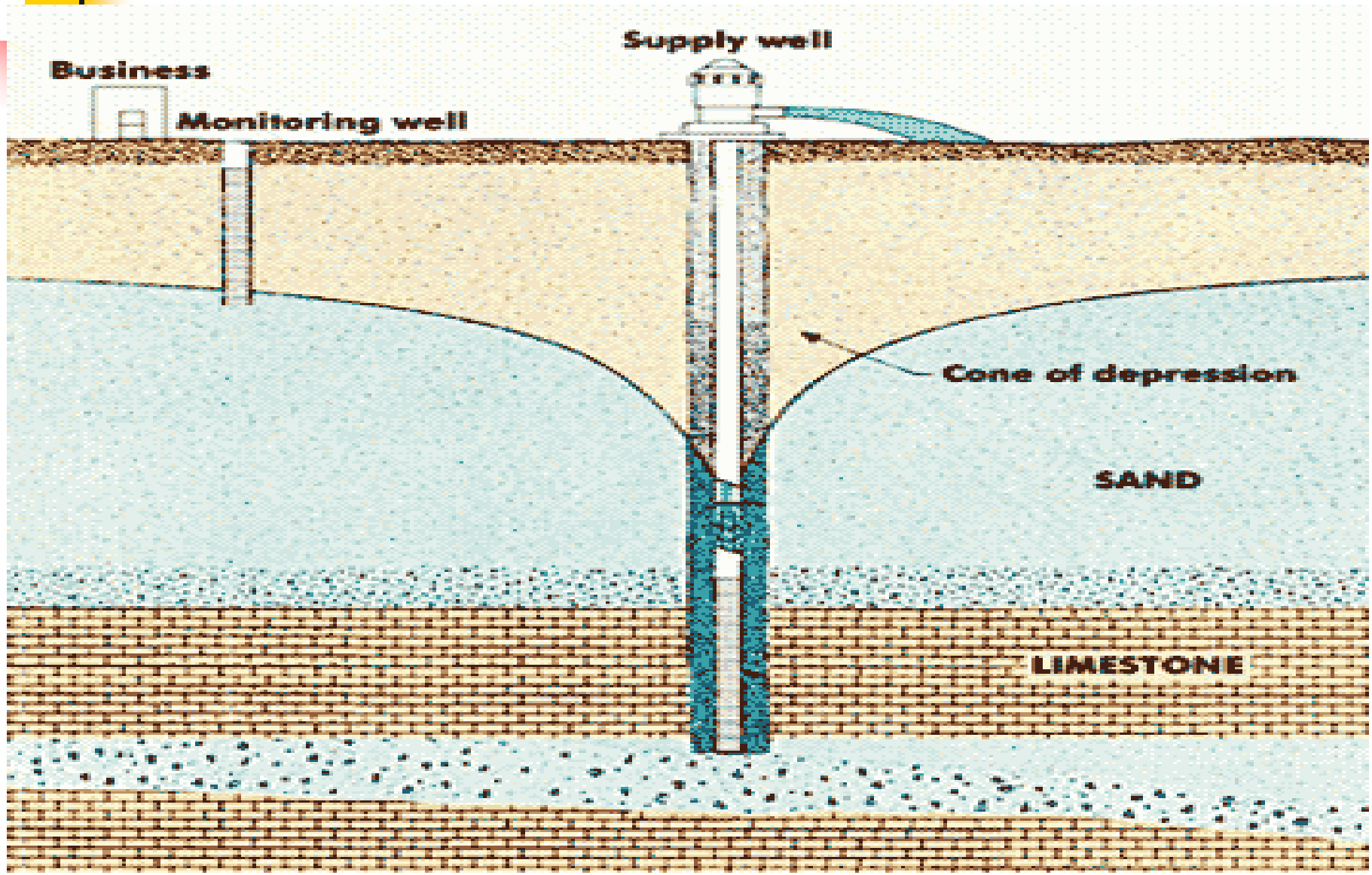
- Providing safe drinking water is what we do
- No matter what the politics may be or that a difficult budget process limits what you can do.
- Public health always comes first!







Ground Water Sources…



Surface Water Sources…

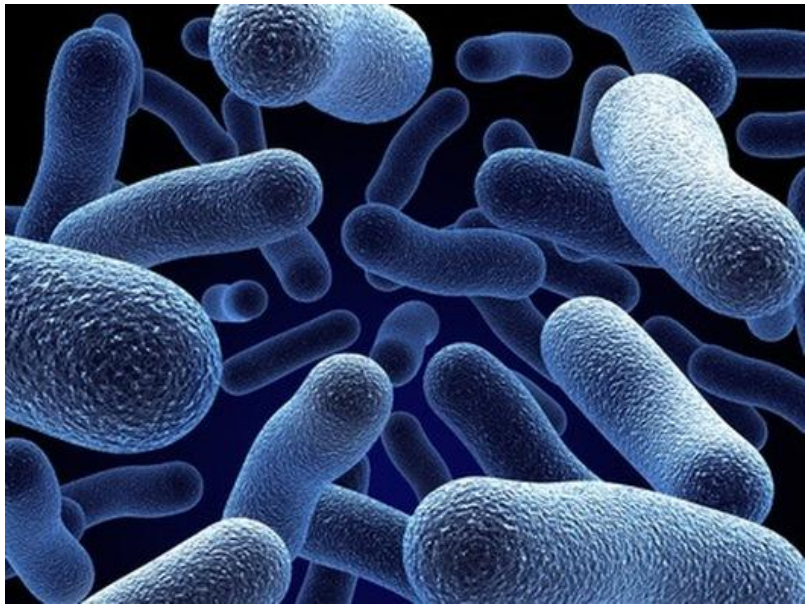


MDC Nepaug Reservoir & Dam

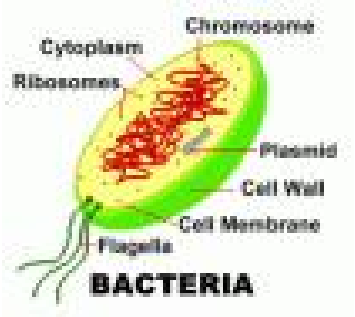
Water on the Earth's surface. This is a common source for large cities and includes rivers, lakes, and reservoirs. Treatment and monitoring are different than for groundwater sources.

Pathogenic

- **Disease causing organisms**
- **Includes viruses, cysts, or bacteria**
- **Causes diseases such as typhoid, cholera and dysentery**
- **Organisms that don't cause disease are non-pathogenic**
- **Process to kill is called disinfection**

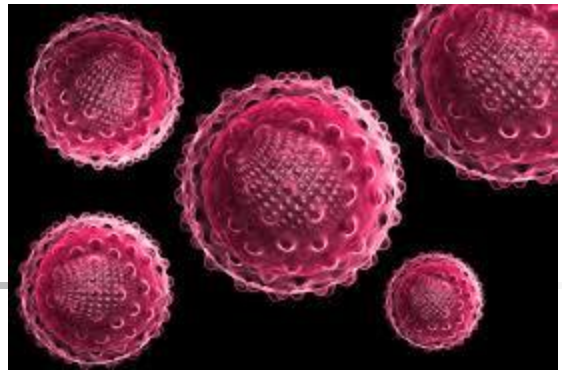


Bacteria



Organism	Disease	Primary Source
Shigella	Bacillary disentary	Human Feces
Salmonella	Salmonellosis	Human/animal Feces
E. Coli	Gastroenteritis	Human Feces
Vibro Cholerae	Cholera	Human Feces

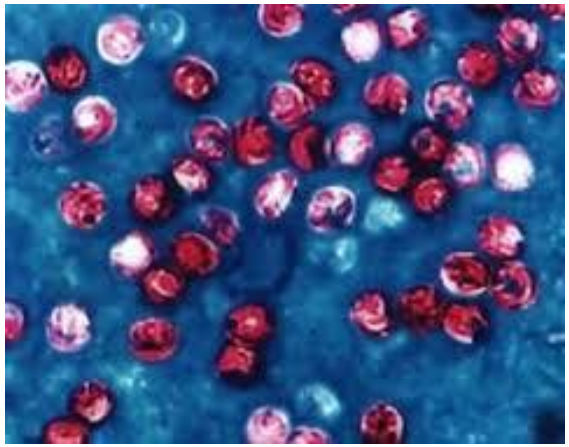
Viruses



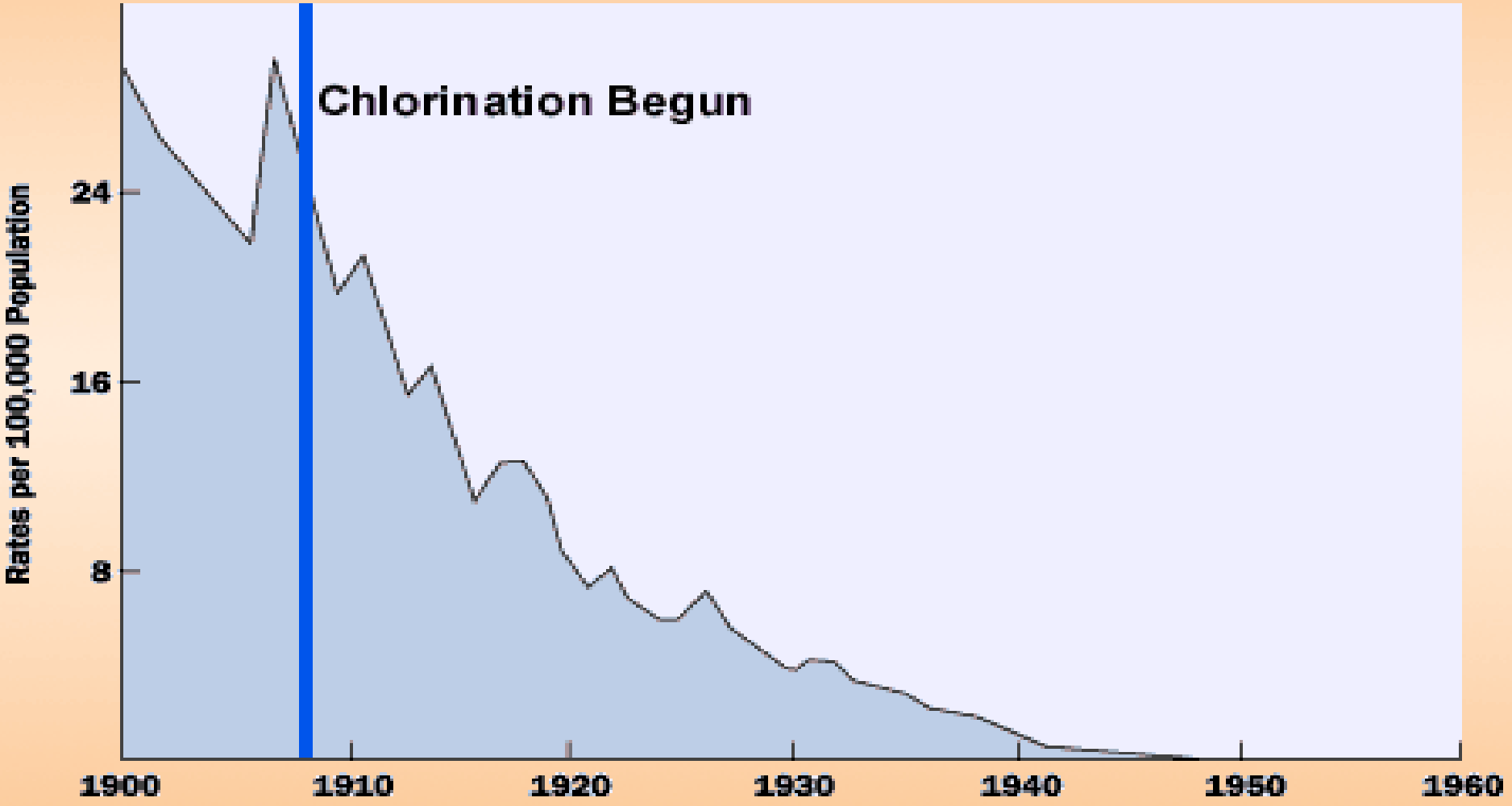
Organism	Disease	Primary Source
Hepatitus A	Infectious Hepatitis	Human Feces
Coxsackievirus A&B	Aseptic meningitis	Human Feces
Rotavirus	Gastroenteritis	Human Feces
Adenoviruses	Upper respiratory & Gastrointestianilln	Human Feces

Protozoans

Organism	Disease	Primary Source
Giardia lamblia	Giardiasis	Human/animal Feces
Cryptosporidium	Cryptosporidiosis	Human/animal Feces
Entamoeba histolytica	Aomebic dysentary	Human/animal Feces



Death Rate for Typhoid Fever
United States, 1900-1960



Source: U.S. Centers for Disease Control and Prevention, Summary of Notifiable Diseases, 1997.

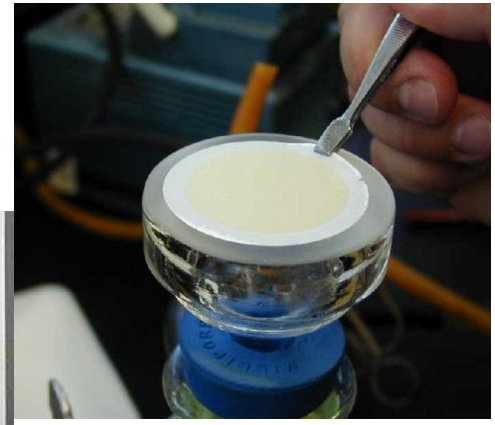
Poll 1

What is a pathogen?

a) A caustic chemical
b) A bacteria, virus, or protozoa that causes disease
c) A check valve
d) A disinfection byproduct

Methods of Detection

- Membrane Filter Test
- Multiple-tube Fermentation Test
- Colilert, P/A

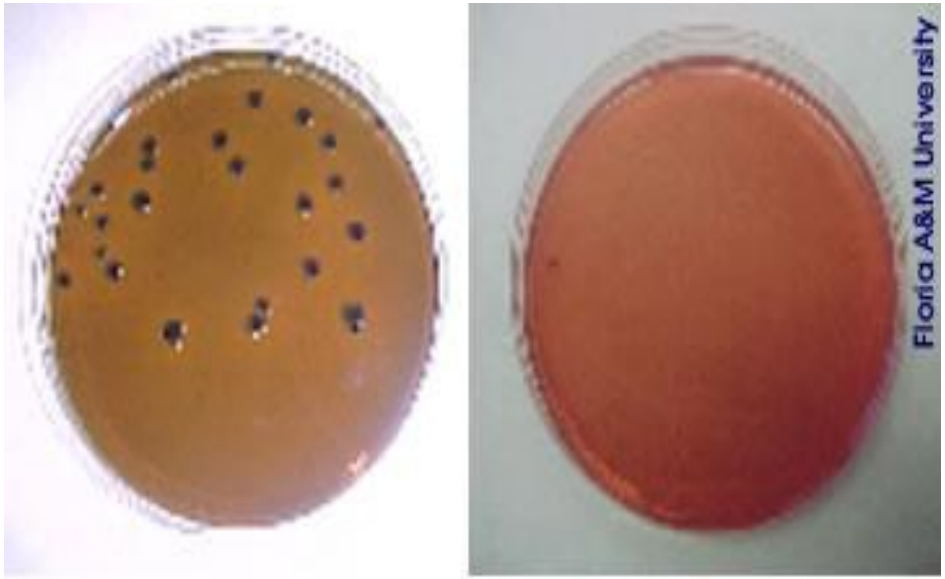






Disinfection Definition

- Process to kill or inactivate most microorganisms in water.
- There are several ways to disinfect
- Chlorine is most popular method because of cost and it leaves a residual throughout the system
- Other methods include UV and ozone



BEFORE
UV Light Exposure

AFTER
UV Light Exposure

Methods of Disinfection

- Heat; boiling
- UV light
- Chemical
  - *Chlorine (three types)
  - *Ozone
  - *Chlorine Dioxide
  - *Chloramination







Three Types of Chlorine

- **Calcium Hypochlorite or HTH (High Test Hypochlorite) Dry Powder 65%**
- **Sodium Hypochlorite is Liquid:**

***Bleach 5%**

***T-Chlor 15%**

- **GAS 99.9% considered 100% for calculations**

***extremely corrosive with water/humidity**

***compressible**

***changes to liquid at 82 psi**

***68 deg. F**

***2.5 times heavier than air**

***greenish-yellow color**

*** Must meet NSF approval**







What is OZONE?

- Ozone is a natural component of the earth's upper atmosphere, where it is primarily formed photo chemically.
- Ozone doesn’t leave a lasting residual



UV

- Is the only method of disinfection that does not alter the pH, taste, or affect the chemical composition of water.
- Operates best when Suspended Solids is <10 – 15 mg/L & Turbidity is <5 – 10 NTU.

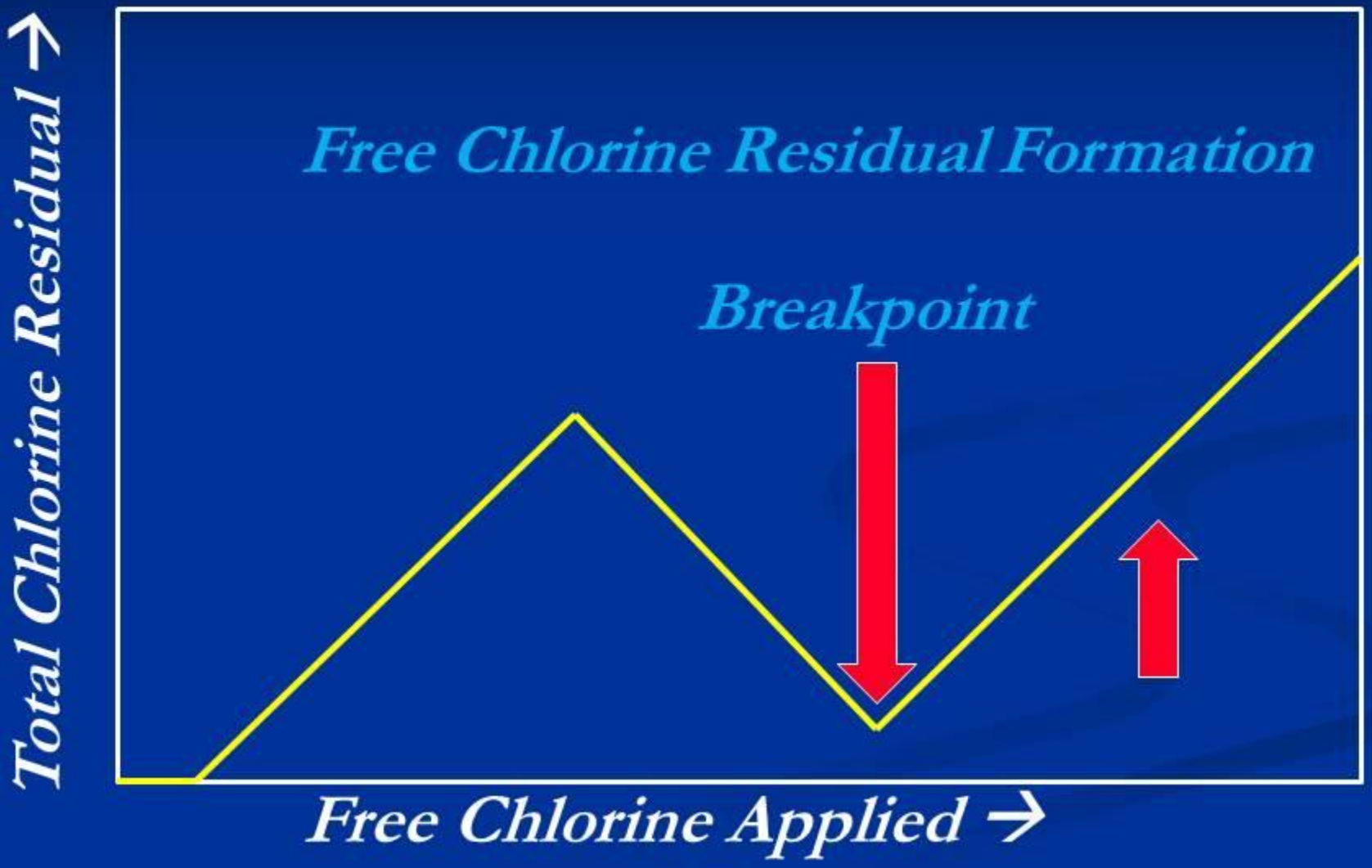




Chlorine Terms

- **Free Chlorine-** chlorine remaining in water after chlorination
- **Total Chlorine-** sum of combined residual chlorine & free available chlorine
- **Demand-** difference between the chlorine added and the chlorine remaining

Chlorine Breakpoint Curve



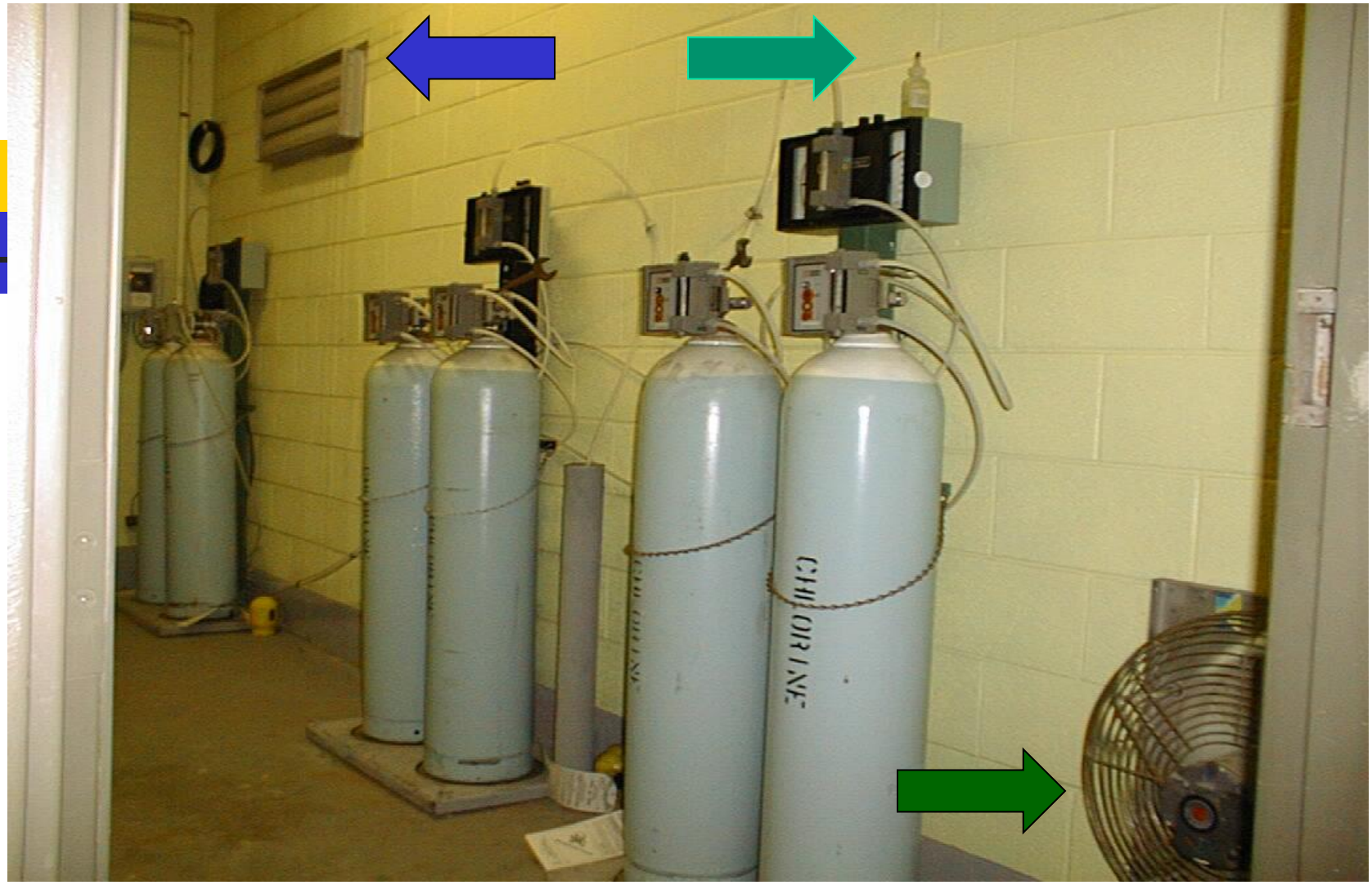
MOST©

Chlorinators

- Gas- Dry or Direct Feed (uses pressure from cylinder)
  *Solution feed
  -gas mixed w/H2O under pressure
  -vacuum feed the water pulls Cl2
- Hypochlorinators - Dry or Liquid Uses
  -Systems with Low flows
  -Emergencies
  -Intermittent- seasonal (winter use)
  -Clean deposits on pump parts with an acid solution







Note air intake at top, exhaust fan at bottom, ammonia bottle for checking leaks (vapors look like white smoke).

Typical Hypochlorinator



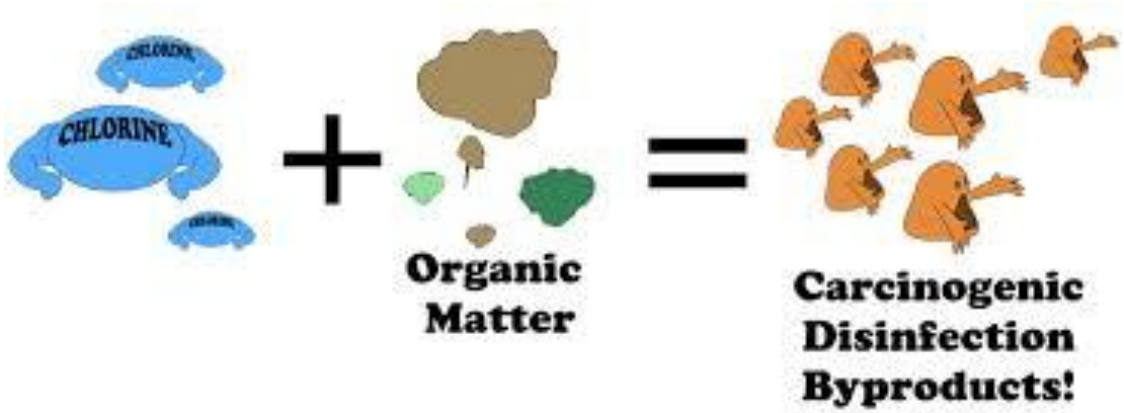
Chloramination

- Cloramines are a reaction between applied chlorine and ammonia
- When done intentionally it can reduce tastes and odors
- Chloramines are a weaker disinfection than chlorine



Disinfection By-products

- TTHM- Total Trihalomethanes
- Combination of free chlorine and organics (Carbon)
- Warmer temperatures and pH form THM's faster

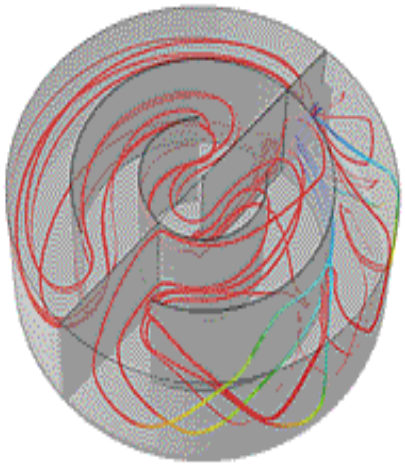


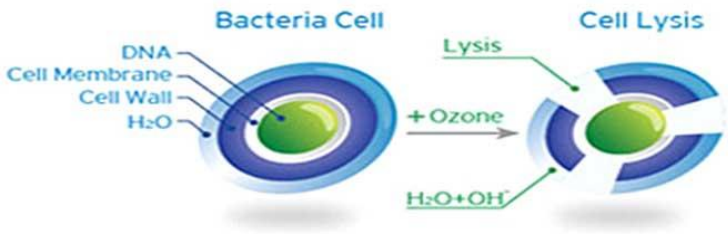
5 Principles of Chlorine Disinfection

- Concentration
- Contact time
- Temperature of the water
- pH of the water
- Foreign substances in the water

Concentration & Contact Time

- If chlorine concentration is decreased then the contact time must be increased
- Longer detention times would have higher bacteria kill rates
- A minimum of 0.2 mg/L leaving the chlorination station and a measurable residual should be maintained at the extremities of the distribution system
- Chlorine penetrates the cell wall





Dt = volume (in gallons) / flow rate (in gallons/time)

Temperature

- **Low temperatures the bacteria kill rate is lower**
- **Chlorine residual will remain longer in cold water**
- **Chlorine dosages should be adjusted with changes in water temperatures**
- **Higher temperatures cause faster rates of THM formation**



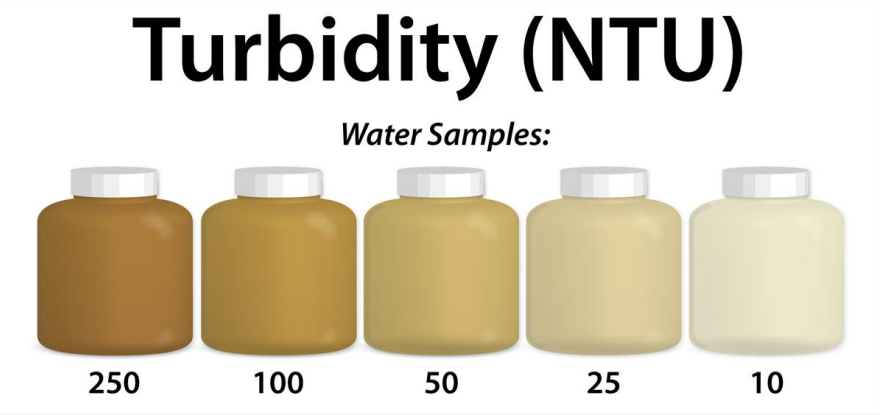
pH

- pH should be checked routinely
- If the pH of the water system is raised for corrosion control, then the chlorine dose needs to be raised to maintain an effective level
- Chlorine is most effective at a pH of 7.0



Turbidity

- **Chlorine is effective only if it comes in contact with bacteria**
- **Turbidity can prevent good contact time and protect pathogens**
- **Chlorine also reacts with organic matter & ammonia**
- **Can mask the bacteria**



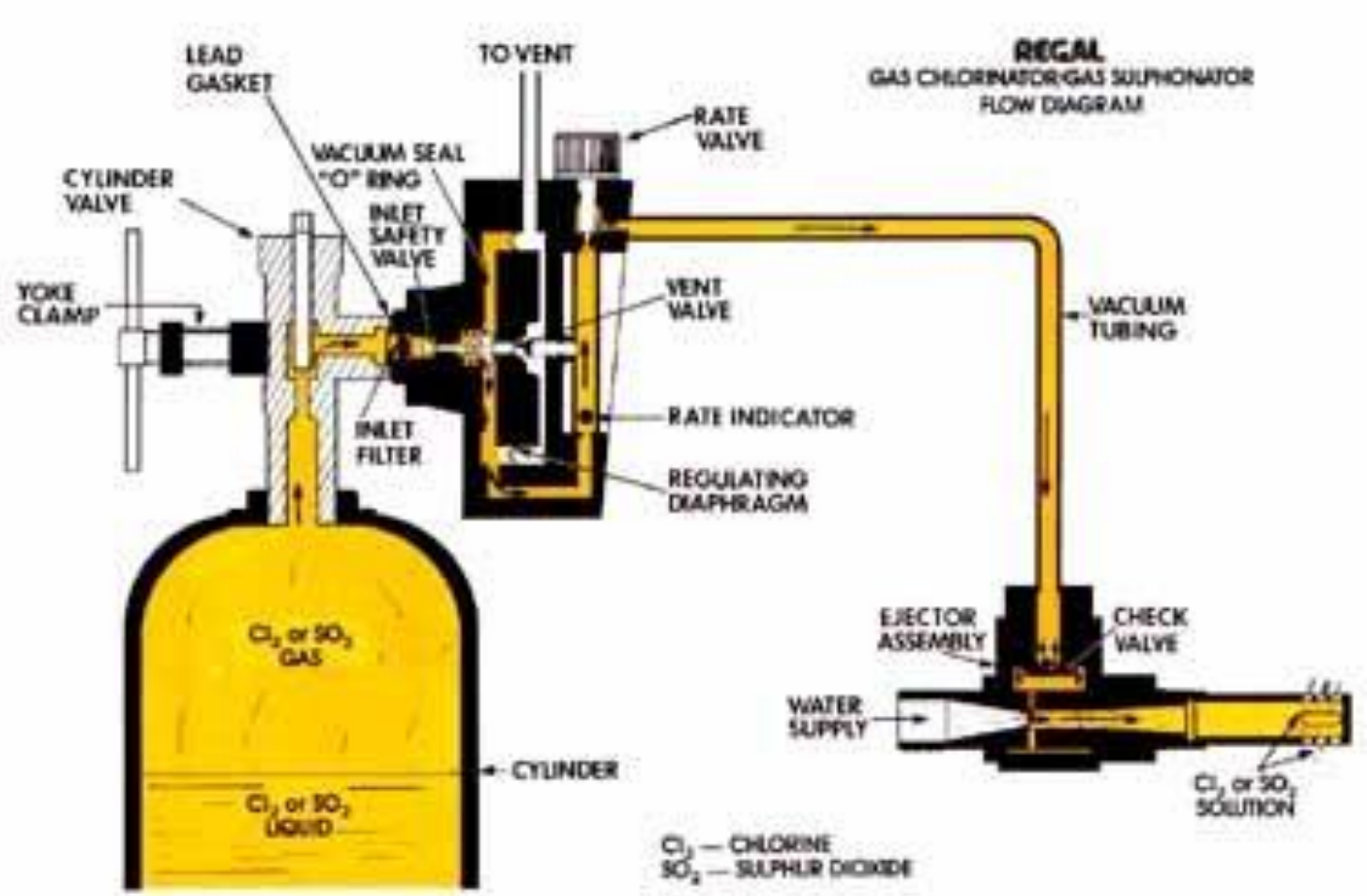


Poll 2

What are three forms of chlorine for disinfection?

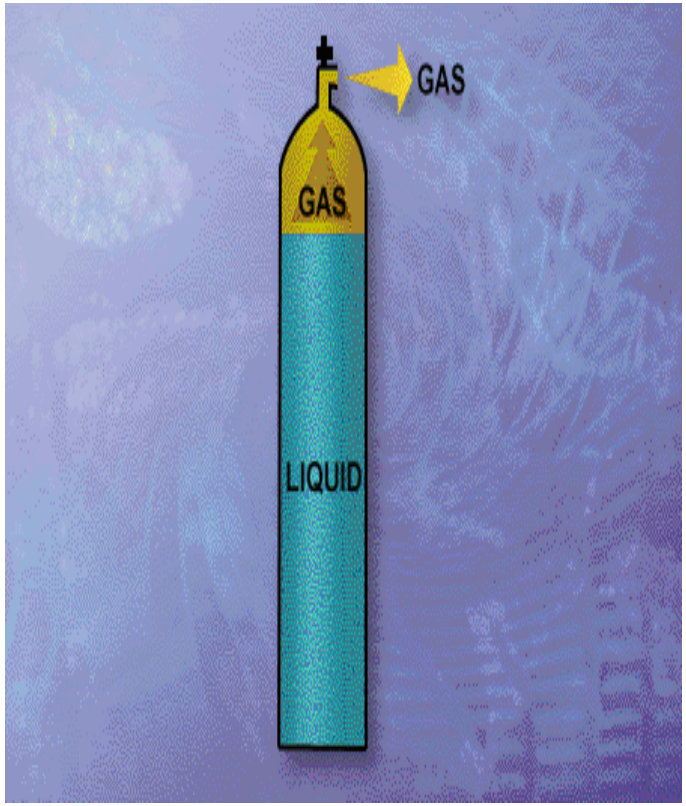
a. Gas chlorine, liquid sodium hypochlorite, and solid HTH
b. Synthetic, organic, and inorganic
c. Acid, base, and neutral
d. pH, lead, and copper

Gas Chlorine System



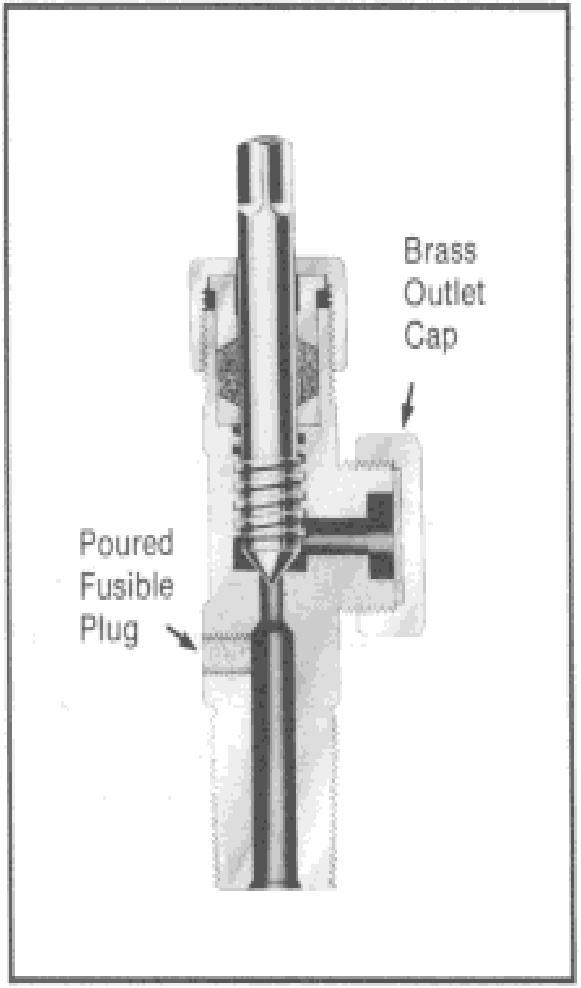
150 lb. Chlorine Cylinders:

- The proper position for the withdrawal of chlorine gas is upright.
- Maximum feed rate is 40 lb/day for each
- A yoke is the connection between the tank & regulator or gas piping



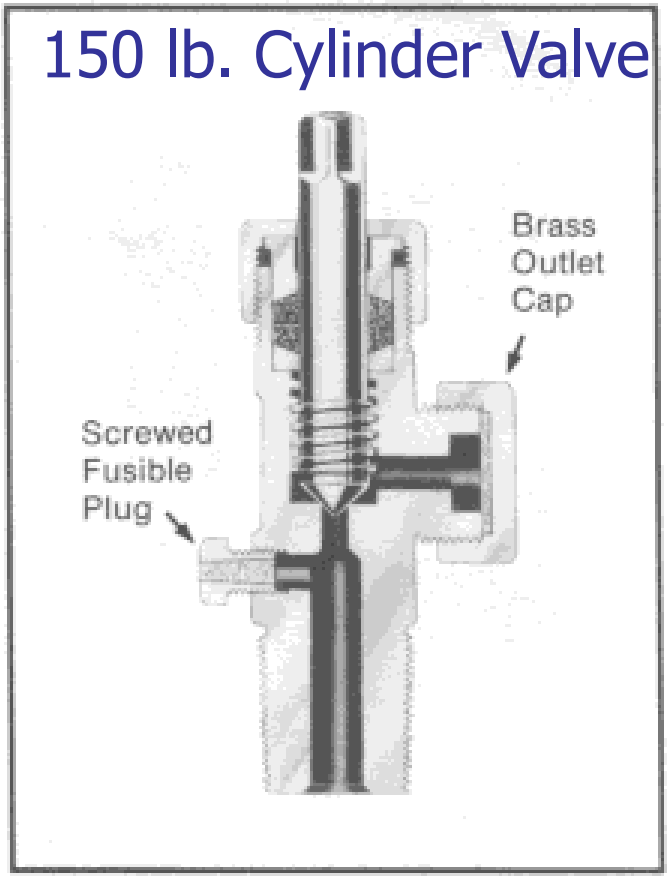
Chlorine Cylinder Valve

- **Always inspect the cylinder valve before opening.**
- **Check cylinder fittings for leaks with ammonia gas**
- **Once the connection has been made, the valve should only be opened 1/4 of a turn & check for leaks.**
- **Close cylinder valve first to allow gas drain from pigtail**

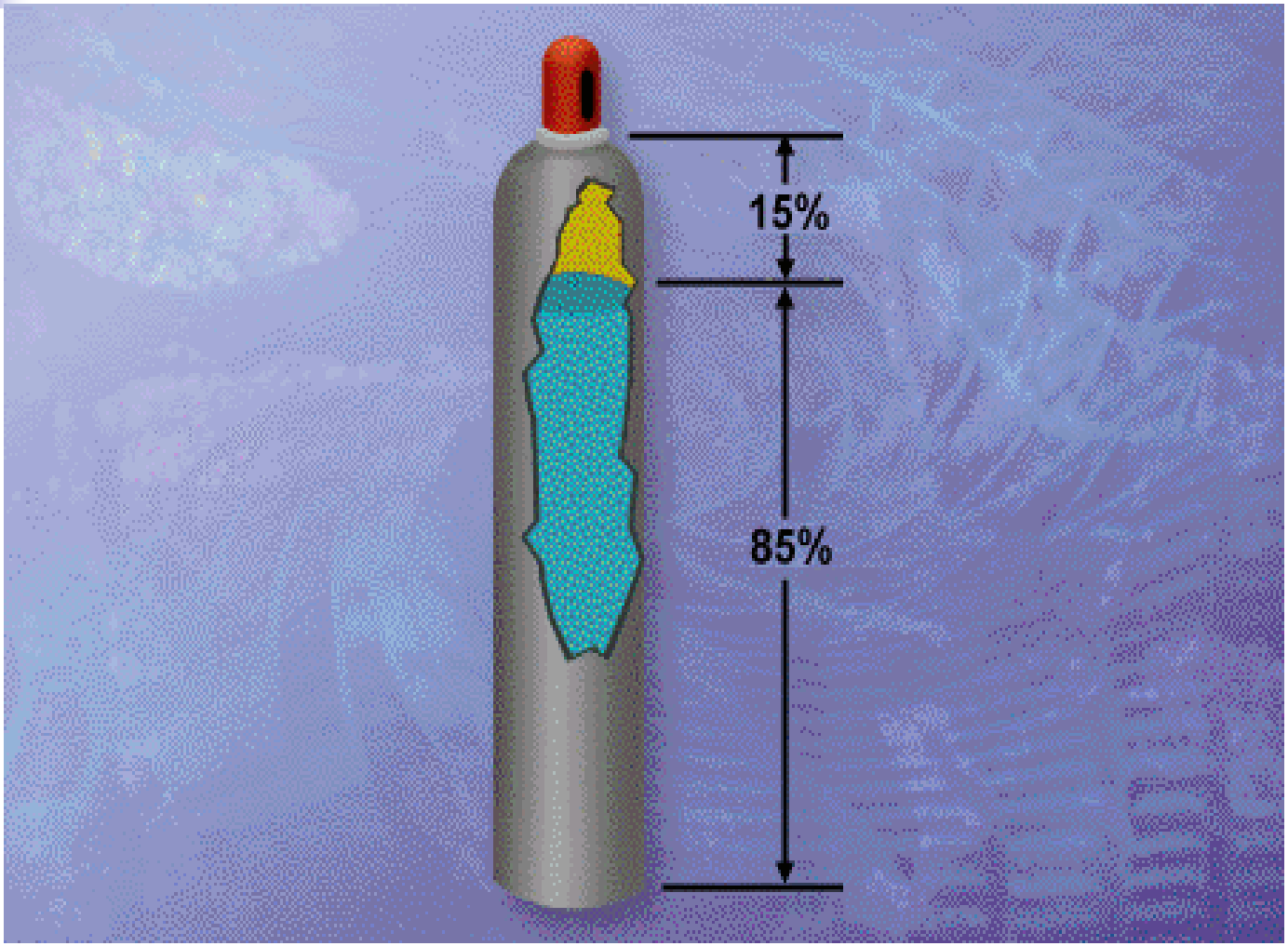


Fusible Plug

- **Safety Device**
- **Made out of lead**
- **Melts between 160 to 165 degrees**
- **Keep cylinders away from direct heat**



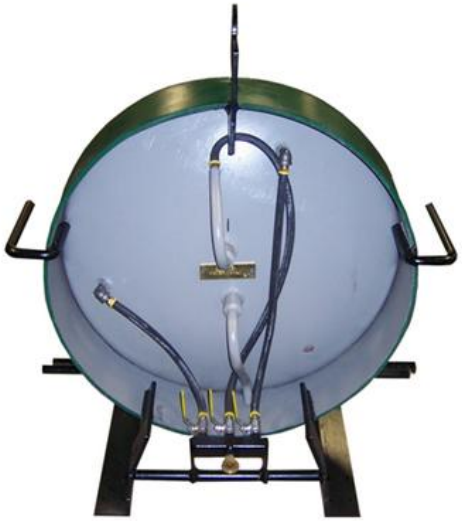
85% Full for Expansion



One Ton Cylinder

- 6 fusible lead plugs- 3 on each end
- Valves are aligned vertically
- Upper is for gas
- Lower for liquid
- 85% full for expansion





Chlorine Cylinders

- **Rupture or tank failure most serious type of leak**
- **For leaks on ton chlorine cylinders, rotate the cylinder until leak is on top**
- **400 lb/day max feed rate for each ton cylinder**



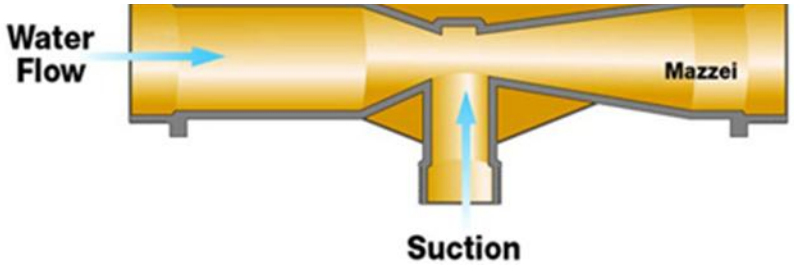
Scales, Ton Cylinders





Chlorine Ejector





Lead Gasket



- **Never** re- use a lead gasket.
- **Never** stack lead gaskets on top of each other
- Tighten connection 1/2 to 3/4 of a turn after making contact with the lead gasket

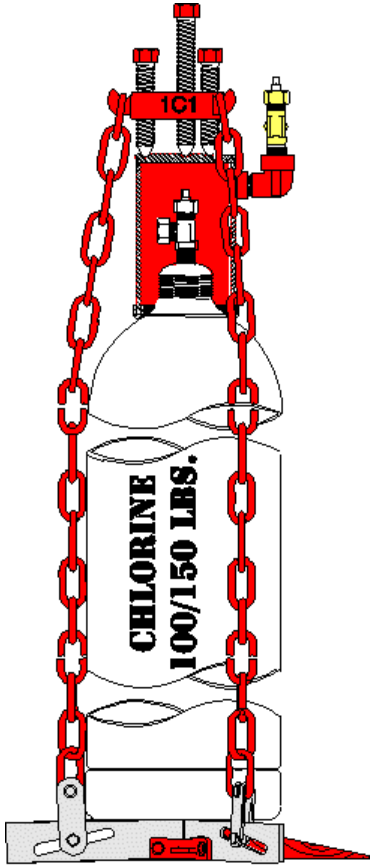
Repair Kits

- A kit for 150 lb.
- B kit for ton cylinders
- C kit for train cars





150 lb Cylinder A Kit



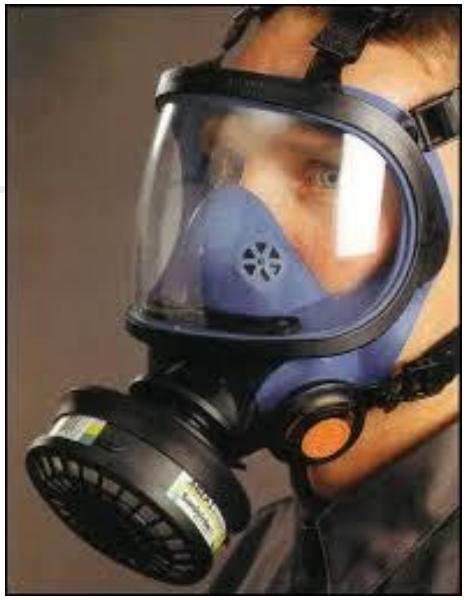


Ton Cylinder Valve Repair



Respirators

- **Canister type masks should be worn during the changing of cylinders**
- **Canister type masks should be used only for escape purposes only, because they don't work in an oxygen deficient environment**
- **SCBA's or fresh air masks should be worn for repairs, troubleshooting, and finding leaks**





Self Contained Breathing Apparatus (SCBA)

- Never enter a room suspected of leak without SCBA

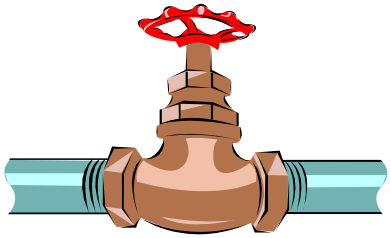


Water Needs to be Metered



Distribution System Components

1. Source of Supply
2. Pumps
3. Piping
4. Valves
5. Hydrants
6. Tanks
7. Service Lines
8. Meters
9. Cross Connections & Backflow Devices
10. Dig Safe



New & Repaired Water Mains

- **Disinfected in accordance with AWWA standard C651**
- **Must be disinfected with some type of chlorine**
- **Tablet or a solution are typically used**
- **Chlorine must be flushed with potable water**
- **Take bacteria samples**



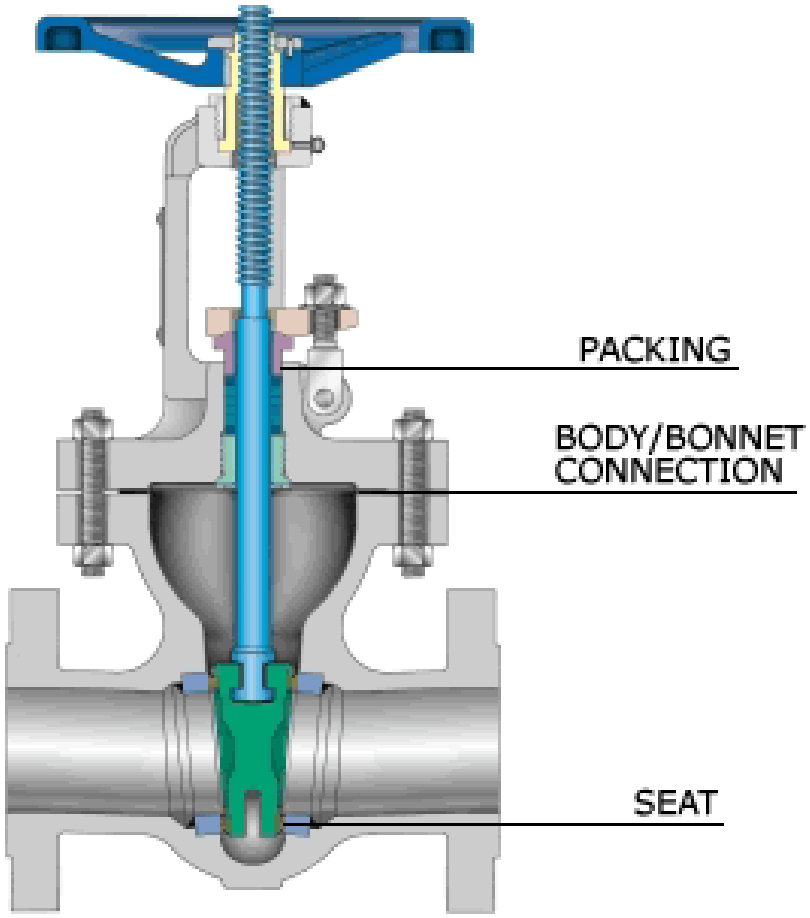


Fire Hydrants

- Dry barrel hydrant used in areas susceptible to freezing.
- Drain hole allows water to drain from barrel so water won't freeze and crack the hydrant.
- Hydrant bury is the distance below the ground to the main connection.
- Because of increased population growth and scaling of pipes, hydrant flow tests should be performed periodically.

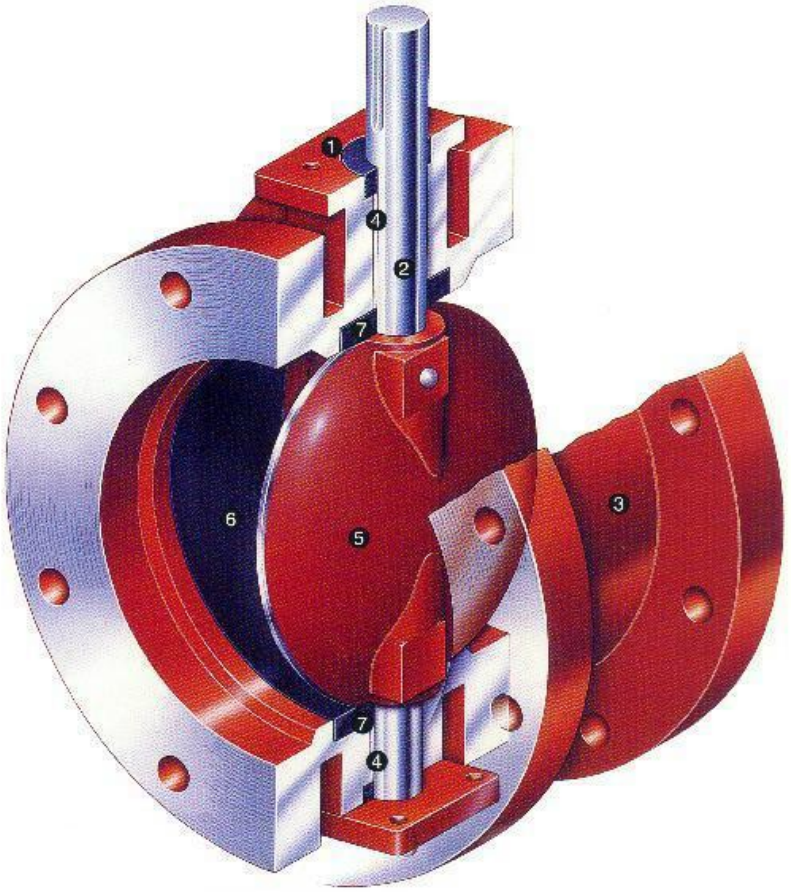


Gate Valves - Isolation



Butterfly Valves -

- Higher resistance to flow
- Operates easily & quickly
- They cost less than gate valves
- Used for flow control



Water Storage Reservoir

- Provides a volume of water to the water system during average and peak demands
- Provides adequate pressures throughout the water systems
- Covered to prevent bacti & algae growth
- Reserve storage
- Fire protection



Poll 3

What is a gate valve used for in a water distribution system?

a. Modulate flow
b. Prevents cross connections
c. Isolation
d. To increase pressure

Poll 4

What kind of pump is used for feeding chemicals?

a. Split case pump
b. Bourdon pump
c. Centrifugal pump
d. Positive displacement pump