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US Territories Water Operator Training Series

Session 14: Alternative Treatment Processes

01/22/2026

Tucker Colvin

Research Scientist

tcovin@unm.edu



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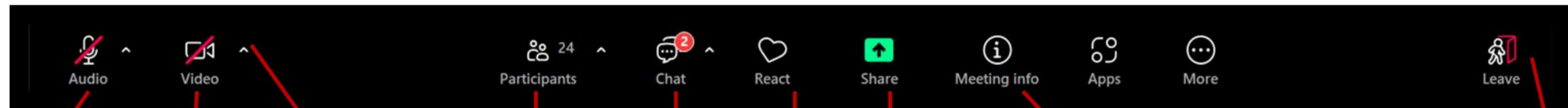
SCHOOL OF
ENGINEERING



This training series is funded by the US 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.



1. Mute/unmute

2. Start/stop
your video

3. Enable Virtual
Background

4. View Meeting
Participants

5. Chat

6. Reactions/raise hand

7. Share
screen

8. Meeting
info

9. Leave meeting

Schedule for 2026:

Date	Topic
1/22/2026	Alternative Treatment Processes (e.g. fluoridation, ion exchange, RO...)
2/5/2026	Drinking Water Treatment Math & Concept Review
2/19/2026	Safety Program Basics (including personal safety, equipment safety, facility safety)
3/5/2026	Lead & Copper Rule, Corrosion Control
3/19/2026	Distribution Systems 1: Hydraulics, Pipe Types, Selection, Installation, and Water Quality
4/2/2026	Distribution Systems 2: Valves, Hydrants, Meters, and Service Connections
4/16/2026	Distribution Systems 3: Storage and Booster Pumping
4/30/2026	O&M: Pumps, Main, and Appurtenance Maintenance (including pressure monitoring, valve exercising, and flushing)
5/14/2026	O&M: Cross Connection Control
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6/11/2026	Sampling & Lab Procedures/Analysis/Interpretation
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Links to recordings and material are available on our website at <https://swefc.unm.edu/home/op-cert-trainings/>

Pacific Island Territories Operator Certification Trainings

This page is a repository of Wastewater and Drinking Water Operator Certification (Op Cert) Training Webinars offered by the SW EFC for systems in the Pacific Territories. Below you will find the **training webinar schedules (wastewater, then drinking water)** followed by a **training webinar recordings library**.

[Jump to Wastewater Trainings](#) [↓](#)

[Jump to Drinking Water Trainings](#) [↓](#)

Wastewater Training Schedule

Please note all times are local to CNMI and Guam. The times in American Samoa are one day earlier at 11 am.

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

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



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: _____

Other types of treatment

Aeration

Precipitation and filtration

Adsorption

Ion exchange

Lime softening

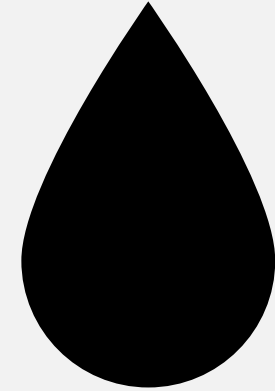
Reverse osmosis

Green sand filtration

Phosphate sequestration

Corrosion control

Fluoridation



Poll: What treatment techniques do you use?

Aeration

Precipitation and filtration

Adsorption

Ion exchange

Lime softening

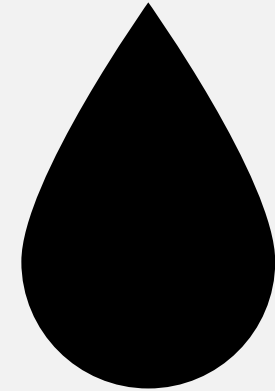
Reverse osmosis

Green sand filtration

Phosphate sequestration

Corrosion control

Fluoridation



Aeration / air stripping

- Addition of air into water to remove dissolved gasses or contaminants

Useful for removal of:

- Carbon dioxide
- Hydrogen sulfide
- Methane
- Volatile organic chemicals
- Radon
- Iron and manganese (oxidation facilitates their removal)
- Tastes and odors



- Works by creating contact between water and air allowing trapped gases to leave water and enter air
- Two types of aerators:
 - Water into air
 - Air into water

Precipitation and filtration

- Oxidation of dissolved solids (arsenic, iron, manganese, etc.)
- Reduction-oxidation reaction (Redox)
 - Transfer of electrons from one substance to another
 - Oxidizers include: chlorine, potassium permanganate, ferric chloride, ozone, aeration, etc.
- OIL RIG
 - Oxidation Is Loss (of electrons)
 - Reduction Is Gain (of electrons)
- Dissolved solids precipitated into a solid
- Filtered out or settled out



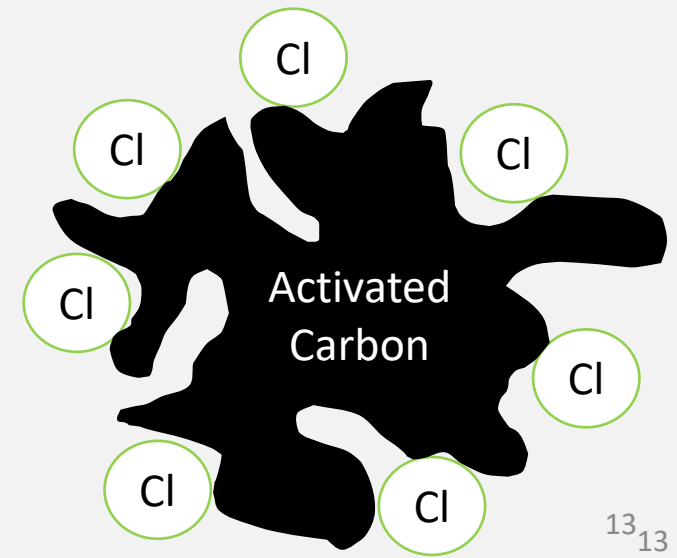
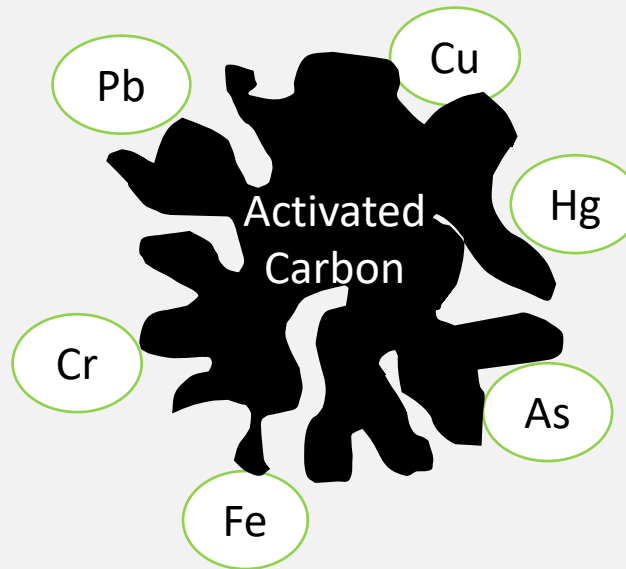
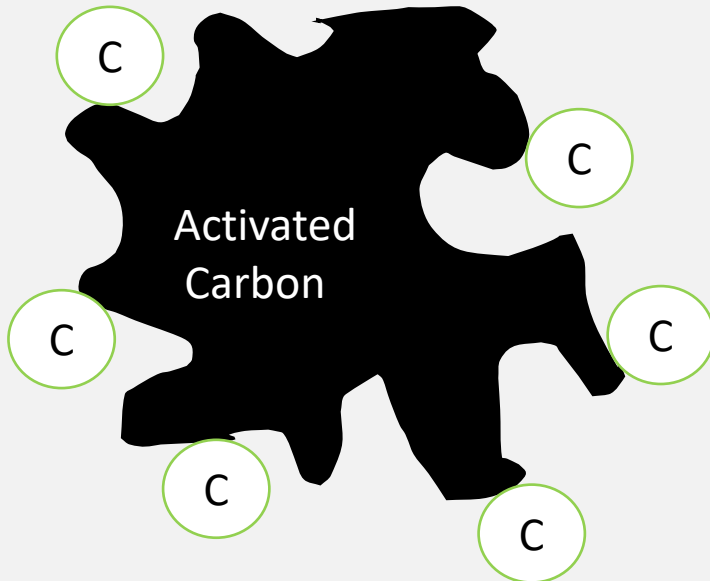
Adsorption

- Removal of organic substances
 - Taste and smell issues
 - Combine with chlorine to form Disinfection Byproducts (DBPs)
- Volatile Organic Carbon (VOCs)
- Synthetic Organic Chemicals (SOCs)
- Chlorine
- Metals



Adsorption process

- Adhesion of contaminant to media with extremely high surface area
- Activated Carbon most common media
 - Granular Activated Carbon (GAC)
 - Powder Activated Carbon (PAC)
- Activated refers to oxidizing carbon by steam
- Wood, nutshells, coconut husks, coal, peat, petroleum residues
- Can be fed into water stream (PAC) or used as filter media (GAC)



Ion Exchange

- Removes many inorganic contaminants (not containing carbon)
- Beads made of zeolite (silica) or synthetic resins
- Replaces contaminant with sodium
- Contaminant removed by regeneration or media replacement
- Removes hardness (replaces calcium and manganese with sodium)
- Can remove arsenic, barium, radium, nitrate, sulfate, iron, manganese, total organic carbon, etc.
- Beads dependent on what is being removed (cation exchangers, anion exchangers)

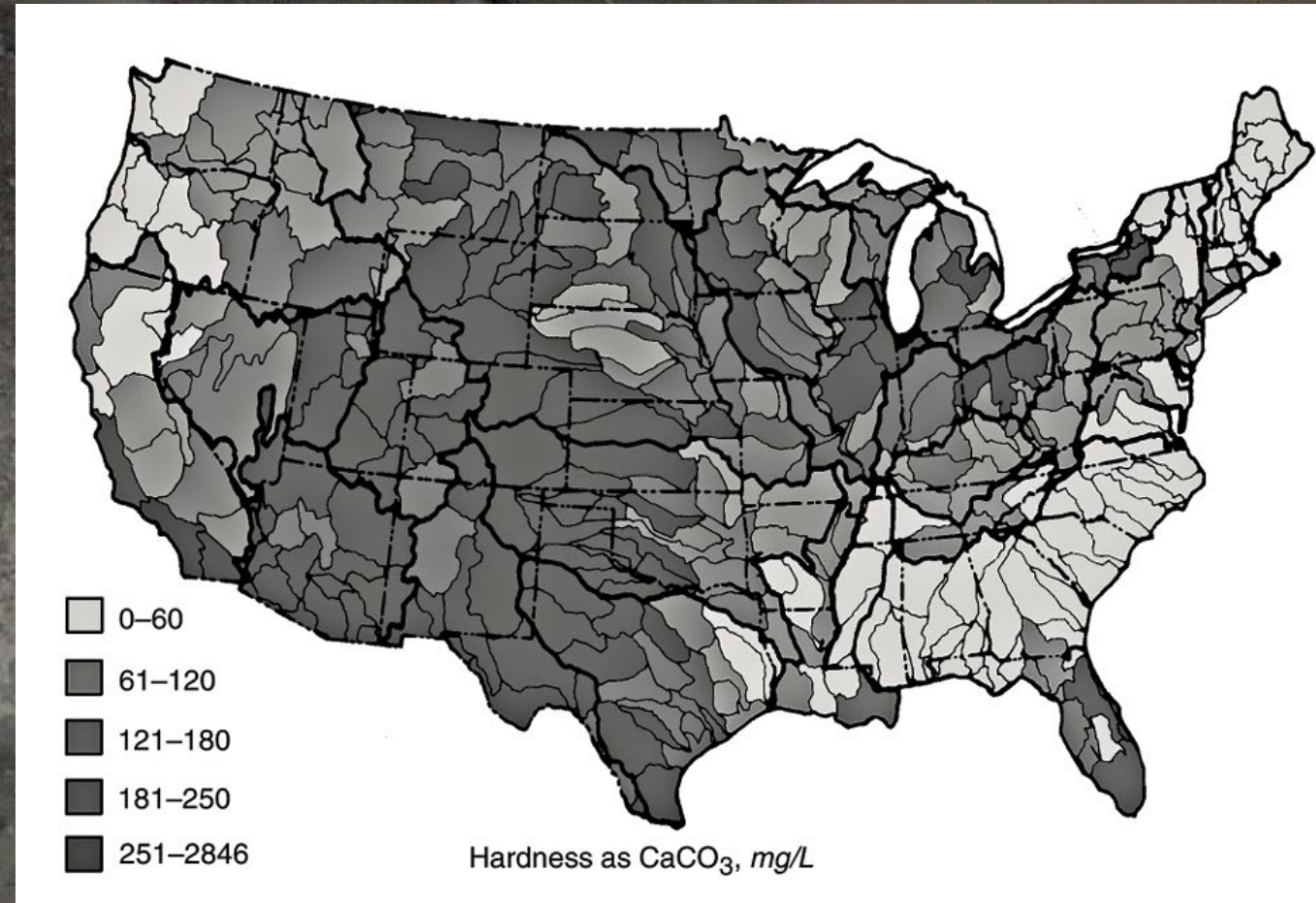


Where does water hardness come from?

- A. Rocks
- B. Air pollution
- C. Water treatment facilities
- D. Bacteria

Water Hardness

- Rain becomes acidic as it has contact with air
- Carbon dioxide makes carbonic acid
- Acidic rain dissolves rocks on the land and creates hard water
- Groundwater typically harder than surface water



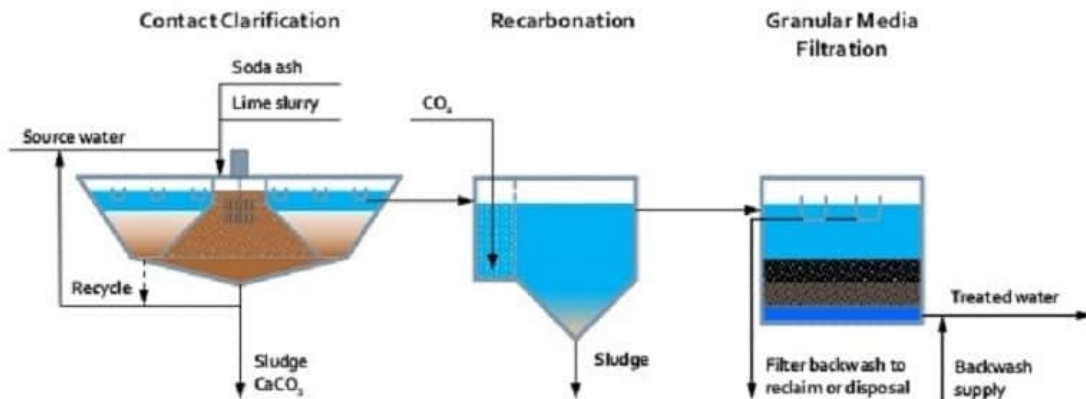
Water Hardness

- Hardness - calcium and magnesium cations in combination with bicarbonate, carbonate, sulfate, nitrate, or chloride anions
- Minerals can precipitate out of solution
- Increased use of soap in households

- Temporary Hardness
 - Bicarbonates of calcium ($\text{Ca}(\text{HCO}_3)_2$) and magnesium ($\text{Mg}(\text{HCO}_3)_2$)
 - Can be removed by boiling and lime softening
- Permanent Hardness
 - Calcium and magnesium sulfates (CaSO_4 , MgSO_4) or chlorides (CaCl_2 , MgCl_2)
 - Cannot be removed by boiling and lime softening

Lime Softening

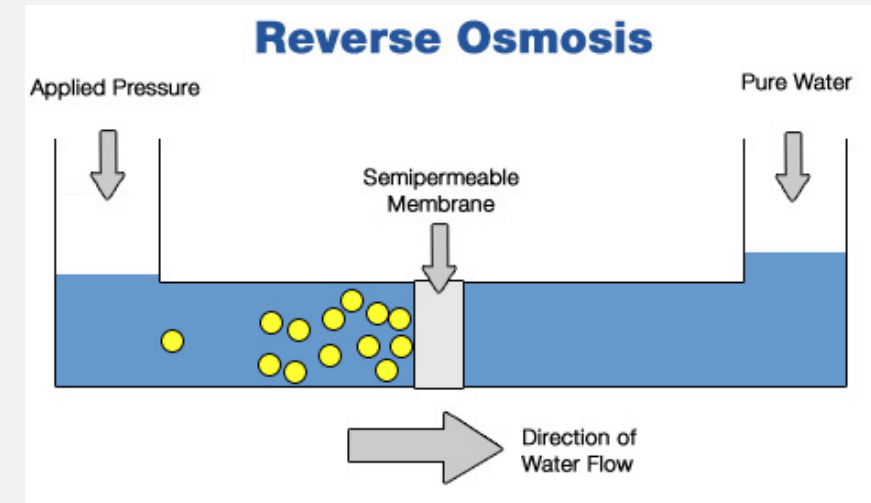
Softening Processes – Single Stage Lime



- Addition of limewater (calcium hydroxide, $\text{Ca}(\text{OH})_2$)
- Increases pH of water
- Calcium carbonate and magnesium carbonate precipitates out
- Settle out in sedimentation basin
- Removes hardness (reduces TDS) whereas ion exchange replaces hardness
- Lime softening cheaper softening than ion exchange
- Only practical for medium and large systems

Reverse Osmosis (RO)

- Water forced through a semipermeable membrane
- Called reverse osmosis because it works by pushing water the opposite direction it would naturally flow through a semipermeable membrane
- High pressure, 300 – 600 psi
- High energy use
- Water passing through membrane called permeate
- Salty water rejected by membrane called reject
- Takes out all minerals and creates aggressive water
- Permeate often mixed with pre-RO water to add back some minerals
- Reject water must be disposed of



RO membrane fouling

Indicators that RO membranes need cleaning:

- Decreased production (flux)
- Increased feed pressure
- Increased salt passthrough
- Membranes cleaned chemically, generally using Clean In Place (CIP) procedure and chemicals approved by manufacturer
- Backwash not used for RO to prevent membrane damage



Cartridge / bag filter

- Proceeds RO units
- Protects membrane from large fouling or damaging material
- Pore size of 5-10 μm
- Cartridge filters can be used outside of RO units
- Can get log removal credit for cartridge filters
- May include activated carbon



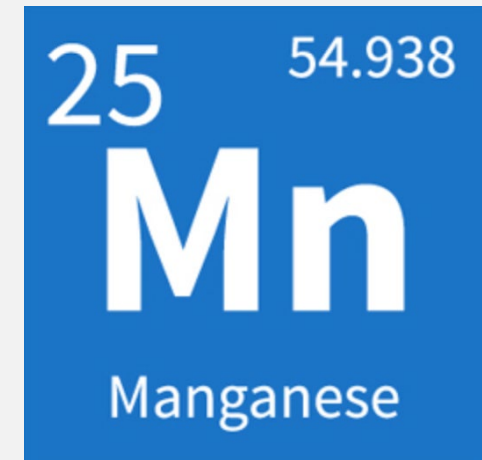
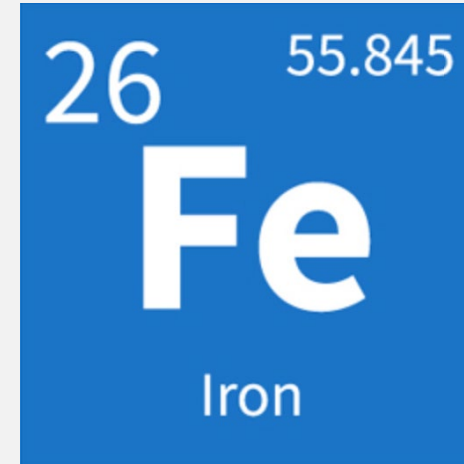
Green Sand Filtration

- Removes iron and manganese
- Combines oxidation and filtration into one step
- Uses potassium permanganate to oxidize iron and manganese from soluble form to insoluble form and filters out
- Requires regular backwashing and regeneration of medium with potassium permanganate solution
- If there is a pink color in finished water, then reduce the potassium permanganate dosage



Phosphate Sequestration for iron & manganese

- Binds to iron/manganese and puts it into solution if it is in an oxidized state and precipitated out of solution
- Only works for low concentrations
- Does not remove iron/manganese from the water
- Takes care of aesthetic issues, such as staining, but not health concerns
- Can create a metallic taste and if dosing is off can give water slippery feel and cause diarrhea.



Where does lead and copper in water most often come from?

- A. Decomposition of rocks
- B. Pipes and plumbing fixtures
- C. Industrial contamination
- D. Biological metabolic functions

Corrosion Control and Scale

- Corrosive / aggressive water
 - Dissolves material into water
 - Health concerns – lead and copper
 - Deterioration of pipe and appurtenances
- Scale forming water
 - Deposition of dissolved minerals onto pipe / appurtenances
 - Decreased lifespan and flow



Corrosivity and Water Stabilization

- Complicated chemical interactions
- Models used to predict corrosivity (Langelier Saturation Index, Ryznar Stability Index)
- Factors that affect corrosivity
 - Dissolved oxygen
 - Total dissolved solids
 - Alkalinity and pH
 - Temperature
 - Flow velocity
 - Type of metal
 - Electrical current
 - Bacteria

- Remedied through altering of pH or alkalinity, sequestering agents, formation of protective coating

TABLE 9-2 Galvanic series for metals used in water systems

Corroded End (Anode)	MOST ACTIVE
Magnesium	+
Magnesium alloys	
Zinc	
Aluminum	
Cadmium	
Mild steel	
Wrought (black) iron	
Cast iron	
Lead–tin solders	
Lead	
Tin	
Brass	
Copper	
Stainless steel	
Protected End (Cathode)	LEAST ACTIVE

Corrosion Potential

pH/Alkalinity Adjustment

- Sodium Hydroxide – increase pH
- Carbon Dioxide – decrease pH
- Muriatic Acid (HCl) – decrease pH
- Calcium Carbonate (increase alkalinity)



Corrosion Control

Reduce corrosivity of water by forming a protective film on pipes due to corrosive water

- Addition of orthophosphate or polyphosphate
- Galvanic corrosion – caused by use of dissimilar metals

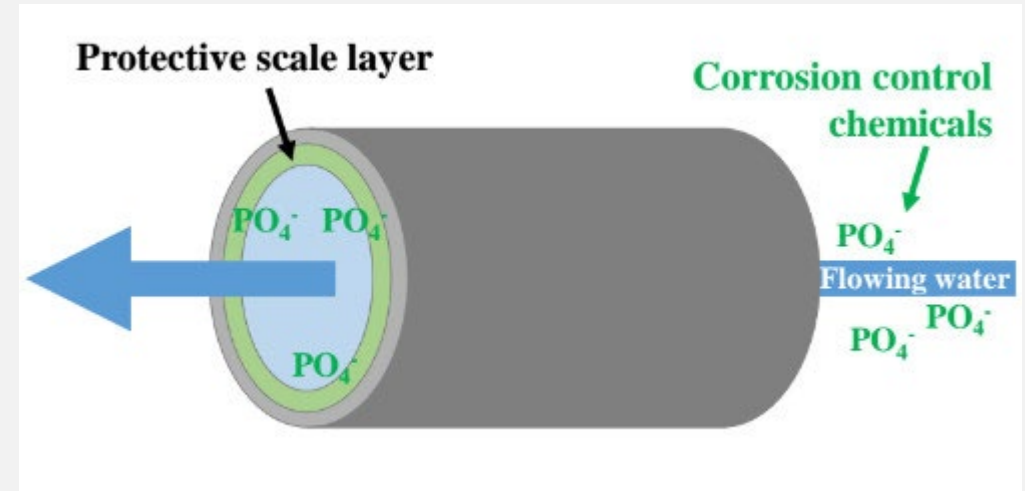


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	LEAST ACTIVE

Corrosion Potential

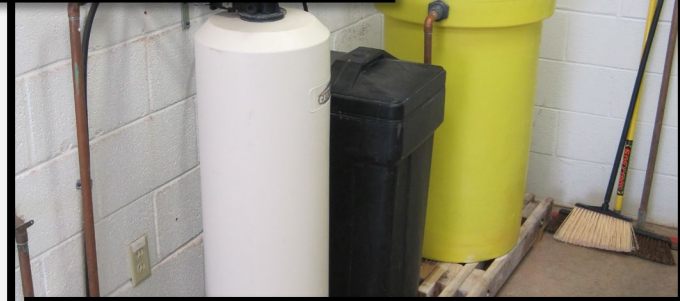
Fluoridation

- Fluoride already present in most water sources
- Fluoride as an additive to prevent cavities and protect dental health
- Recommend concentration of 0.7 mg/L by US CDC
- Process control sampling for fluoride should be done in the plant on the finished water every day
- A spectrophotometer is used to determine fluoride levels in the lab





Questions?



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CONTACT INFORMATION



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SW EFC email:
swefc@unm.edu

Department of Civil Engineering MSCo1 1070
1 University of New Mexico
Albuquerque, NM 87131
505-277-0644
swefc@unm.edu
<http://swefc.unm.edu>