




Corrosion and Stray Voltage with Crazy high PH

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Virginia Water Well Association Winter Meeting

- February 17-18 2021
- Fredericksburg Convention Center
- Live and Virtual Event

We Will Discuss:

What is corrosion?
How does corrosion happen?
How do we recognize Corrosion?
What are various forms of Corrosion?
How do we negate the effects of
Corrosion?

Why discuss Corrosion

Corrosion causes more than 276 Billion dollars in damage every year or
(3.2%) of the GDP

Equipment Rigs-trucks

Tools

Plumbing systems

Well systems

Other items

Sometimes hard to find and repair

Sometimes hard to diagnose

What is Corrosion?

A natural process that converts a refined metal into a more chemically stable form such as oxide, hydroxide, or sulfide.

It is a gradual destruction of materials (usually a metal) by chemical and or electromechanical reaction with their environment.

Most common use means electromechanical oxidation of metal in reaction with an oxidant such as oxygen

RUST is the most common form of Corrosion

What is Corrosion?

Corrosion also occurs in material other than metals

This form is usually referred to as "Degradation"

Alloys corrode due to natural process and exposure

Usually problematic corrosion causes pitting or cracks

Corrosion usually occurs on the surface of materials

All materials will corrode

Passivation and chromate conversion can increase corrosive resistance

What is Corrosion?

Corrosion is considered an electromechanical phenomenon

One spot will have oxidation occur and that becomes an anode. The electrons will move to another spot and reduce oxygen at that spot.

This second spot becomes a cathode.

This occurs due to the H^+ available due to carbon dioxide from air to water.

What is Corrosion?

Three Main Forms

General Attack Corrosion

Localized Corrosion

Galvanic Corrosion

Different Forms of Corrosion

Galvanic	PH & TDS
Crevice	Pitting
Fretting	Erosion
Microbial	Stray
Voltage	
Cavitation	Dissolved
Gasses	
Filiform	

Water's role in Corrosion

Water (H₂O) is the universal solvent

As water dissolves things the PH changes

Neutral water is PH of 7.0

Water below PH of 7.0 is Acidic

Water above PH of 7.0 is Alkaline

PH scale is Logarithmic (Important to remember)

PH alone is rarely the Problem

Common Causes Of Corrosion in plumbing

High PH >8.5

High Dissolved oxygen (DO)

High Co₂

High TDS >500 Potable, TDS >1000 PPM usually a problem

Corrosion causing bacteria (Iron Low Ph <7.0

Bacteria)

Electromechanical issues (Improper grounding) Stray Voltage

Velocity of flow

Sand-grit-solids

Improper installation, flux, not deburring fittings

Galvanic Corrosion

Known as dissimilar metal corrosion

Happens when two different metals connect

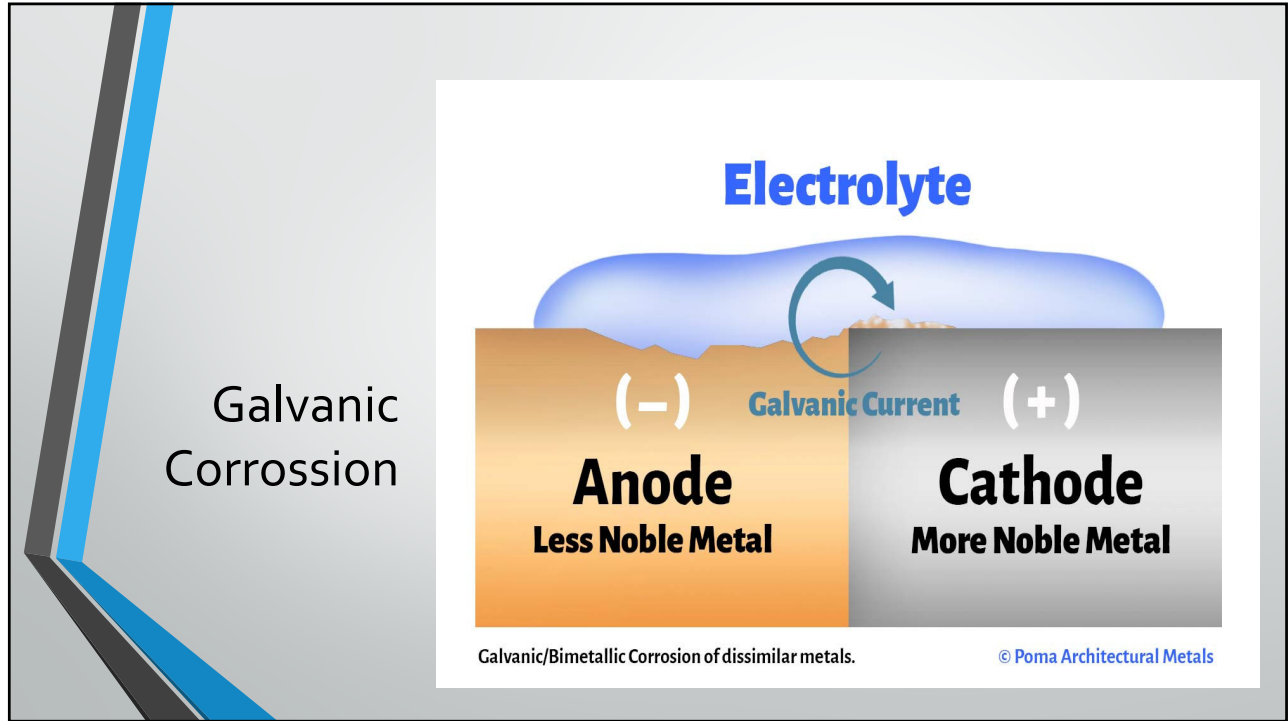
Must be exposed to an electrolyte

Must be in electrical contact (caused by two different metals)

The more active metal corrodes at a faster rate (the anode)

The more noble metal reacts at a slower rate (the Cathode)

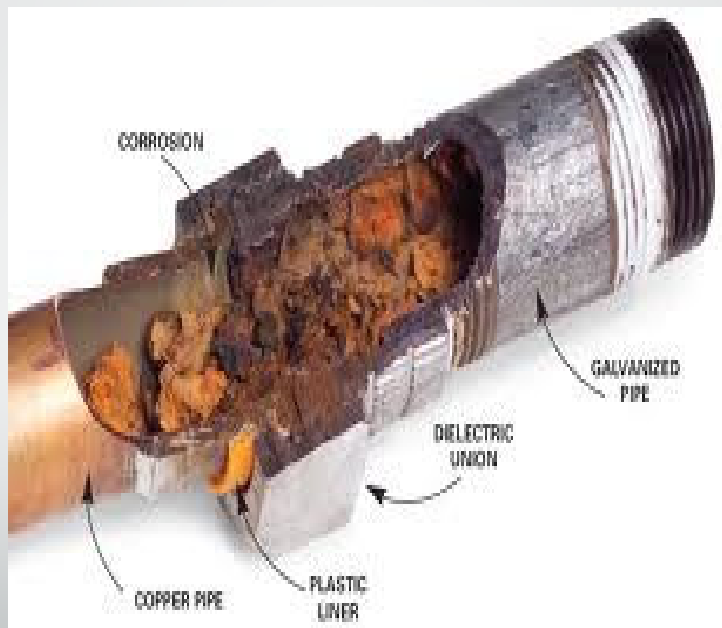
This is why anode rods are used in tank type water heaters
(Sacrificial rod)



Galvanic Corrosion



Galvanic Corrosion



Galvanic
Corrossion



Galvanic
Corrossion



Crevice Corrosion

Known as contact corrosion

Occurs where nonmetal meets metal

Occurs at washers, sand grains, under protective films

Occurs at threaded joints

Keep joints clean

Use proper sealants

Common occurrence on screws and fasteners

Crevice
Corrosion



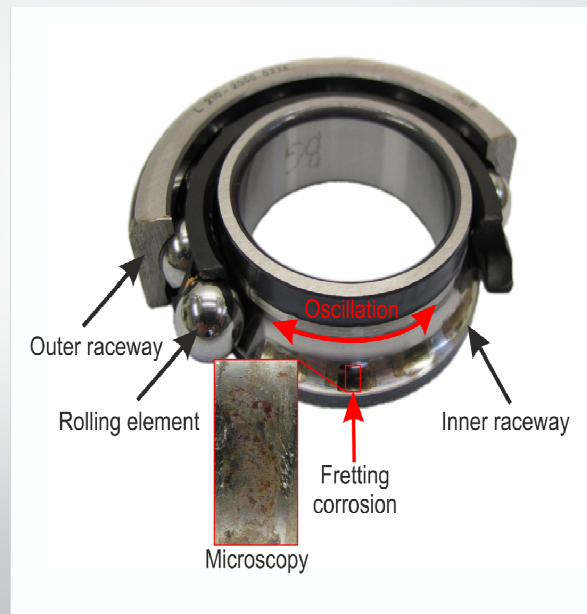


Fretting Corrosion

Associated with contact surfaces
Occurs when different metals rub against one another

Vibration is a big cause
Not lubeing bearings is another cause
Keep items tight to reduce wear

Fretting Corrosion



Microbial Corrosion

Known as **MIC** Microbial influenced corrosion

Pit form underneath layers of living organic matter

IRB or Iron Related Biofilms huge problem for our industry

Biofilms are very corrosive and attach to smooth surfaces

Occur in open air and enclosed pipes/tanks: stagnant pipes big problem

Biocides may help (Not in potable water)

SRB or Sulphur Reducing Bacteria like anaerobic areas, create sulfuric acid

IRB's like aerobic places and lots of oxygen

Remove Food –Oxygen and need to kill it to control it if possible

Microbial
Corrossion



Microbial
Corrossion



Microbial
Corrossion



Microbial
Corrossion



Microbial Corrossion



Cavitation Corrossion

Caused by abrupt creation and collapse of vacumes
and bubbles

Often seen in pumps-volute and impeller damage

Caused by turbulence in the liquid

no flow conditions create an air lock situation

casing becomes very hot and usually loud banging
noise till bearing or seals fail

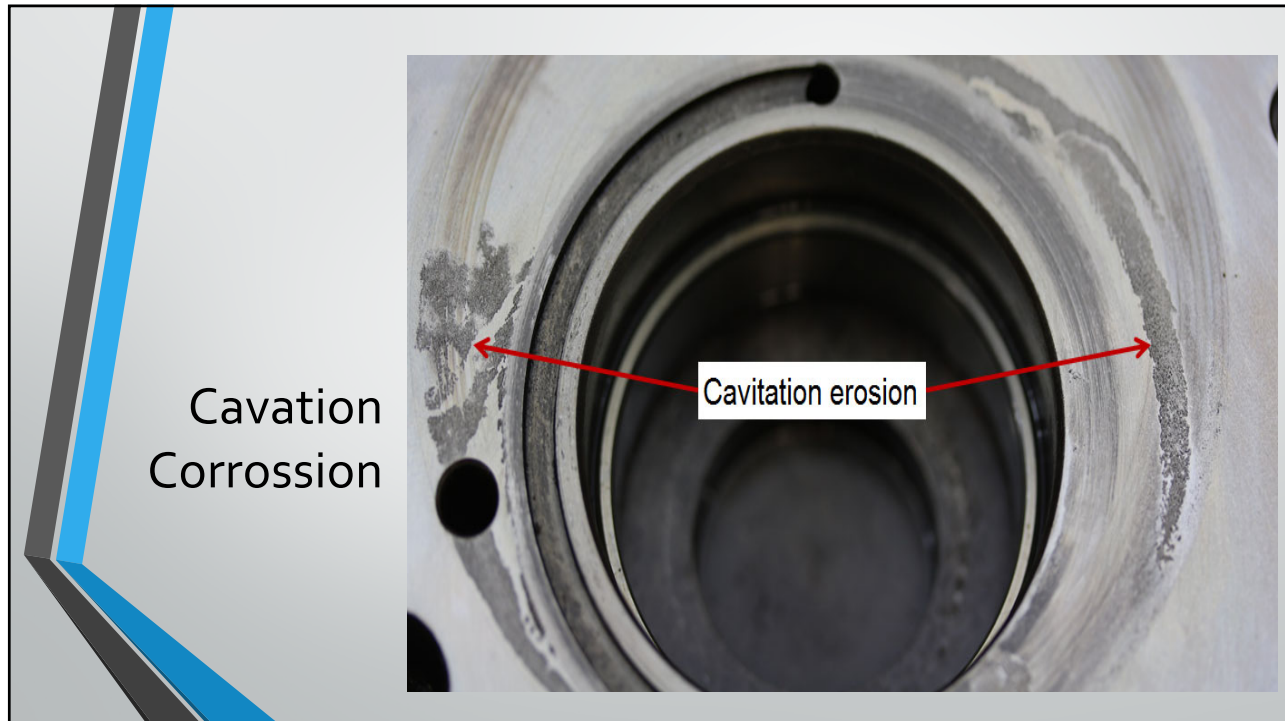
Cavation Corrosion

Found in
Pumps



Pump Cavation

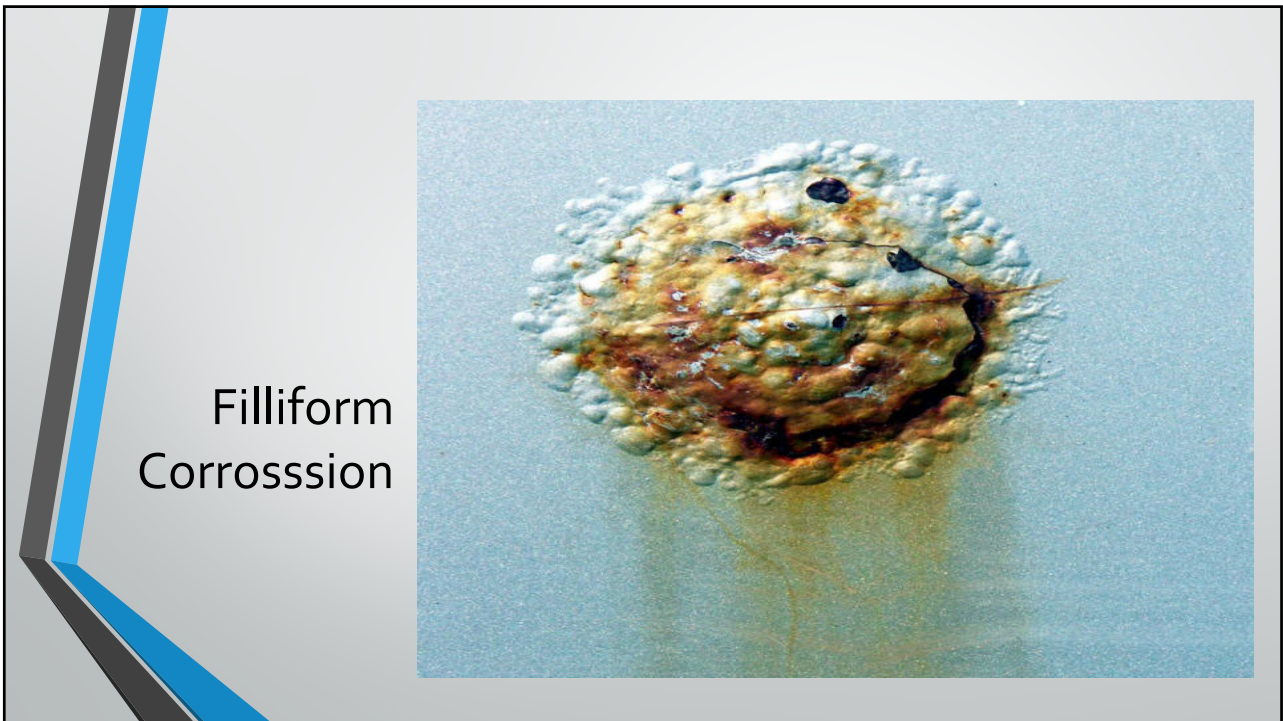
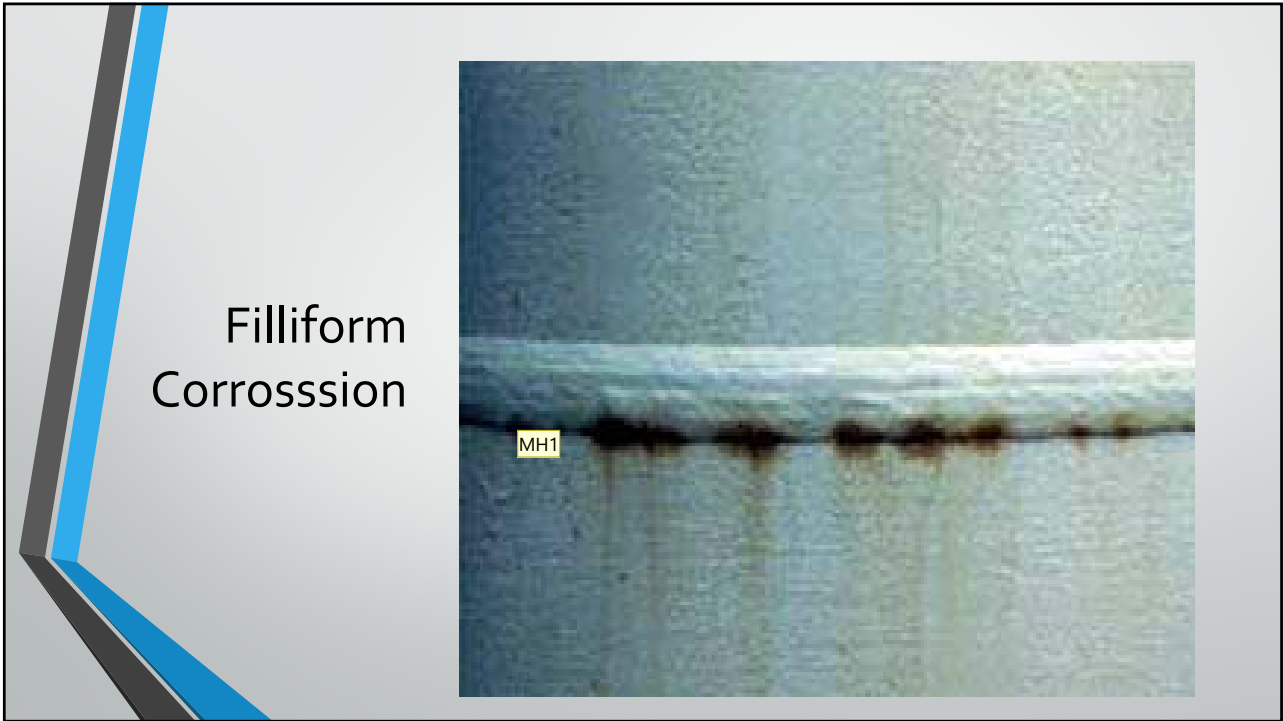




The image shows a schematic diagram of a pipe corner on the left, with a blue layer representing a coating and a grey layer representing the substrate. To the right of the diagram is text describing filiform corrosion.

Filiform Corrosion

Under film corrosion
Looks like thread-like fibers
Oxygen concentration main cause
Found under flat sections of paint
Surface type corrosion
May look like worms under the paint surface
Advoid quick dry paints and properly prepare surface



PH Corrossion

Really about dissolved gas-CO₂

Water under PH 7.0 considered Acid

Water over Ph 7.0 Considered Alkaline or Basic

PH scale is Logrithmic

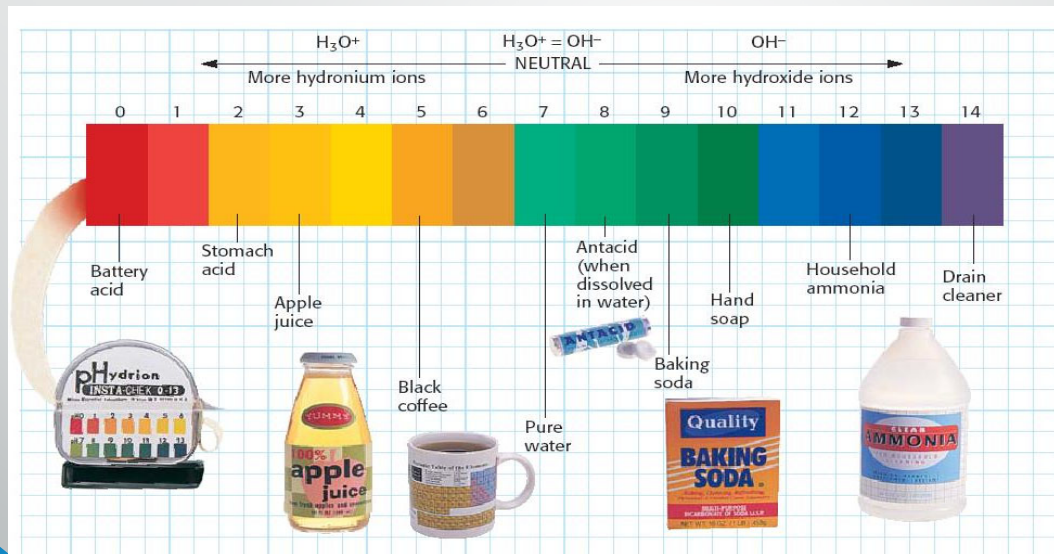
Each point is greater 6.0-7.0 is 10 times


5.0 is 100 times

4.0 is 1000 times

PH must be checked at the jobsite gasses come off too quickly


Lab results are always high compared to site conditions





PH Corrossion

- Low PH:<7.0
 - Metallic smell and or taste
 - Blue green stains
 - Green water
 - Thinning of copper pipes
- High PH>8.5
 - Bitter tasteing water
 - dry itchy skin-dry scalp
 - Spotting on glassware-shower doors-cars



PH Corrossion

- Correct Low PH
 - Calcite/corsex Filter
 - Chemfeed system with Soda ash
- Correct High PH
 - R/O
 - Chemfeed-Citric acid or white vinegar

TDS Corrossion

TDS is total amount of inorganic and organic substances in solution,
Includes minerals, salts. Cations, anions, solids less than .2 micron

TDS is the sum of all + charges and – charged ions in the water

A measurement of what we cannot see

Pure water does not conduct electricity-TDS does

TDS is measured in PPM parts per million or mg/l milligrams per liter

High TDS water encourages electrons to flow

<500 PPM TDS drinking water

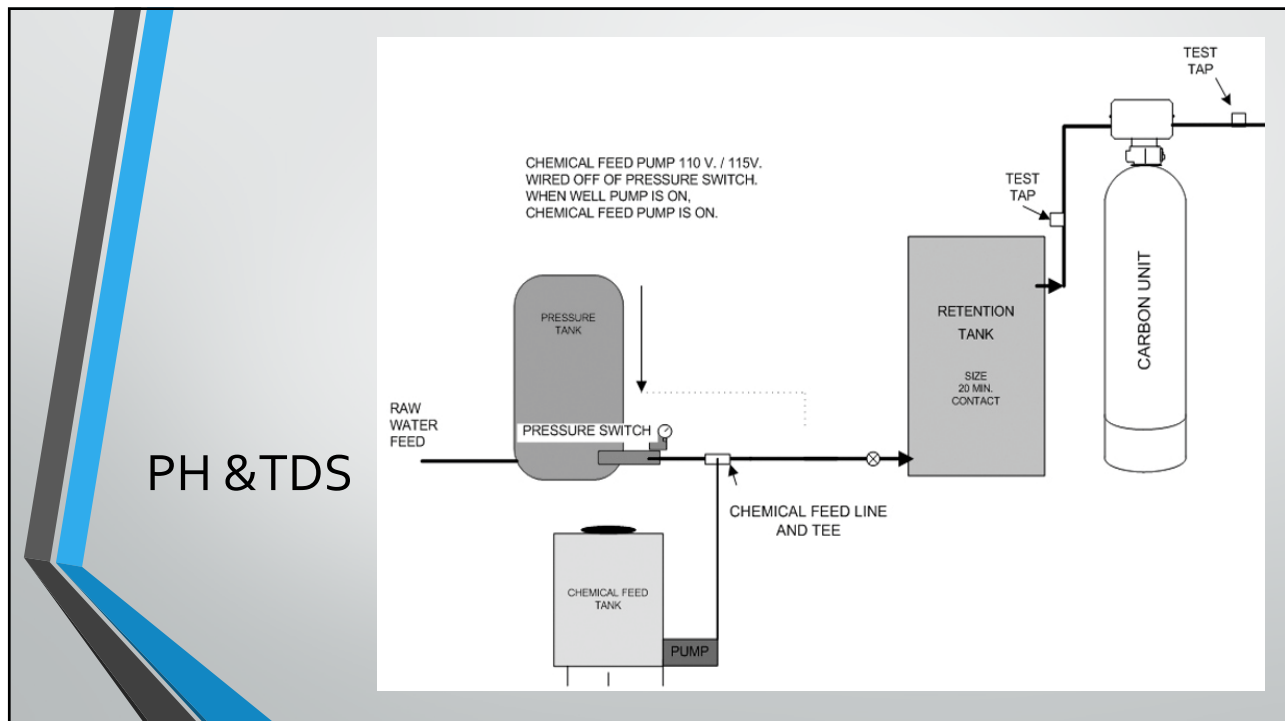
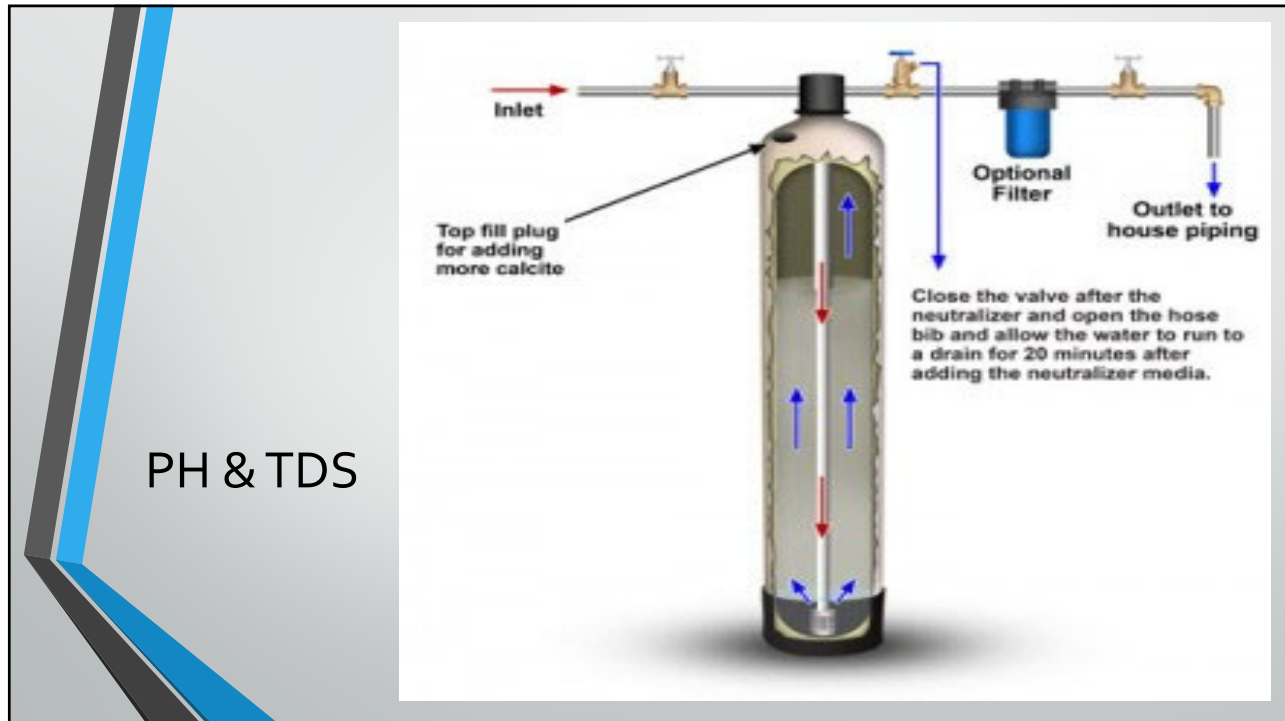
>500 PPM TDS causes issues

TDS Corrossion

Lower TDS: R/O

ION Exchange - Cation/Anion

Raise TDS: Calcite/Corsex Filters



Pitting Corrosion

One of the most destructive forms

Creates holes downwards into the surface

Usually found under (rust bubbles)

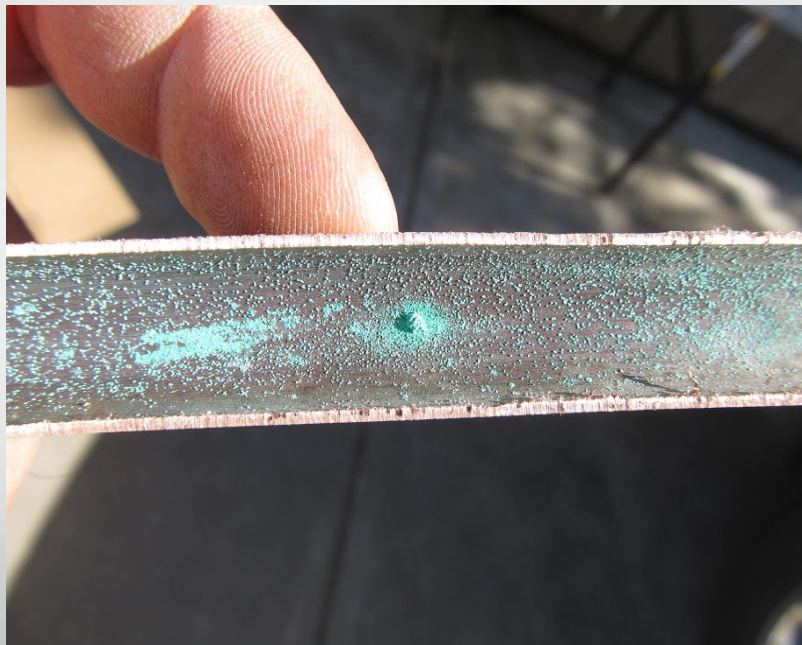
Area under the bubble usually lower in PH and higher in Chlorides

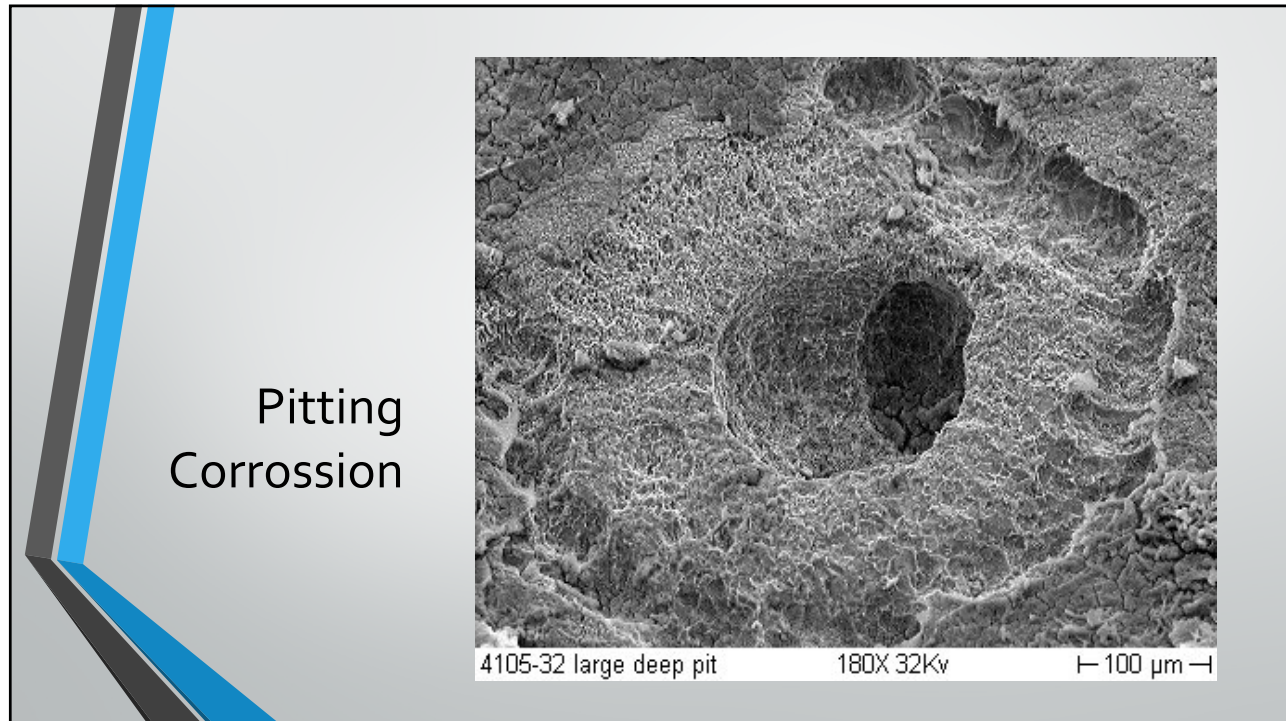
Harder to find and locate than other forms

Usually small at surface and larger as it penetrates

Many different causes

Pitting
Corrossion

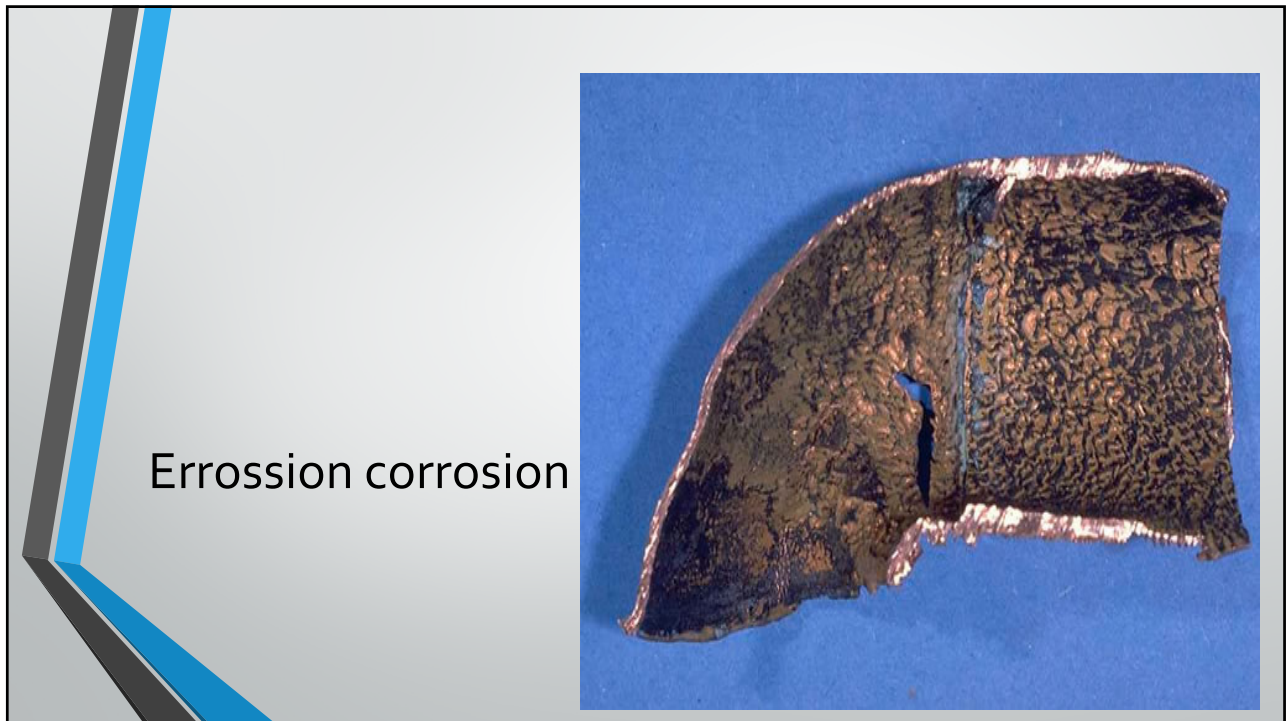


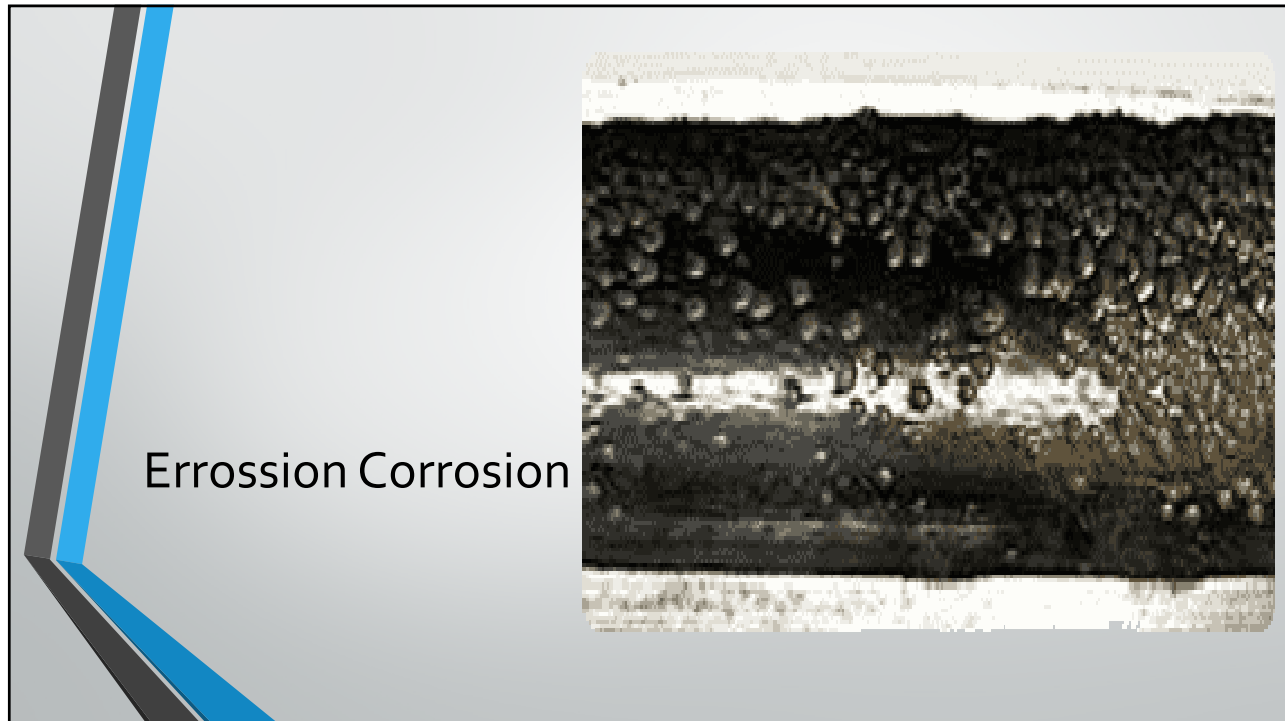


Errrosion Corrosion

Combined aggressive chemicals and high fluid surface velocities

- Can be caused by quick on/off of fluid or object
- Usually occurs on clean objects
- Causes a “wearing away” of the metal
- Caused by fitting size reduction in piping systems
 - Caused by oversized pumps
 - Caused by under sized pipes
- More common than realized





Errossion Corrosion

Pipe Size	5fps	6fps	7fps	8fps	Red Zone	
					9fps	10fps
1"	13 gpm	16 gpm	18 gpm	21 gpm	23 gpm	26 gpm
1.5"	31 gpm	37 gpm	43 gpm	50 gpm	56 gpm	62 gpm
2"	52 gpm	63 gpm	72 gpm	82 gpm	92 gpm	102 gpm
2.5"	73 gpm	88 gpm	102 gpm	117 gpm	131 gpm	146 gpm
3"	113 gpm	136 gpm	159 gpm	181 gpm	203 gpm	227 gpm
4"	196 gpm	234 gpm	274 gpm	313 gpm	353 gpm	392 gpm

Stray Current Corrosion

Confused with galvanic or dissimilar metals corrosion

More common than you think

Found with other forms of corrosion

Voltage can be measured on the piping or in the water

use a good quality digital voltmeter

must go to a solid ground-preferrable a ground rod

Improper grounding and or bonding biggest cause

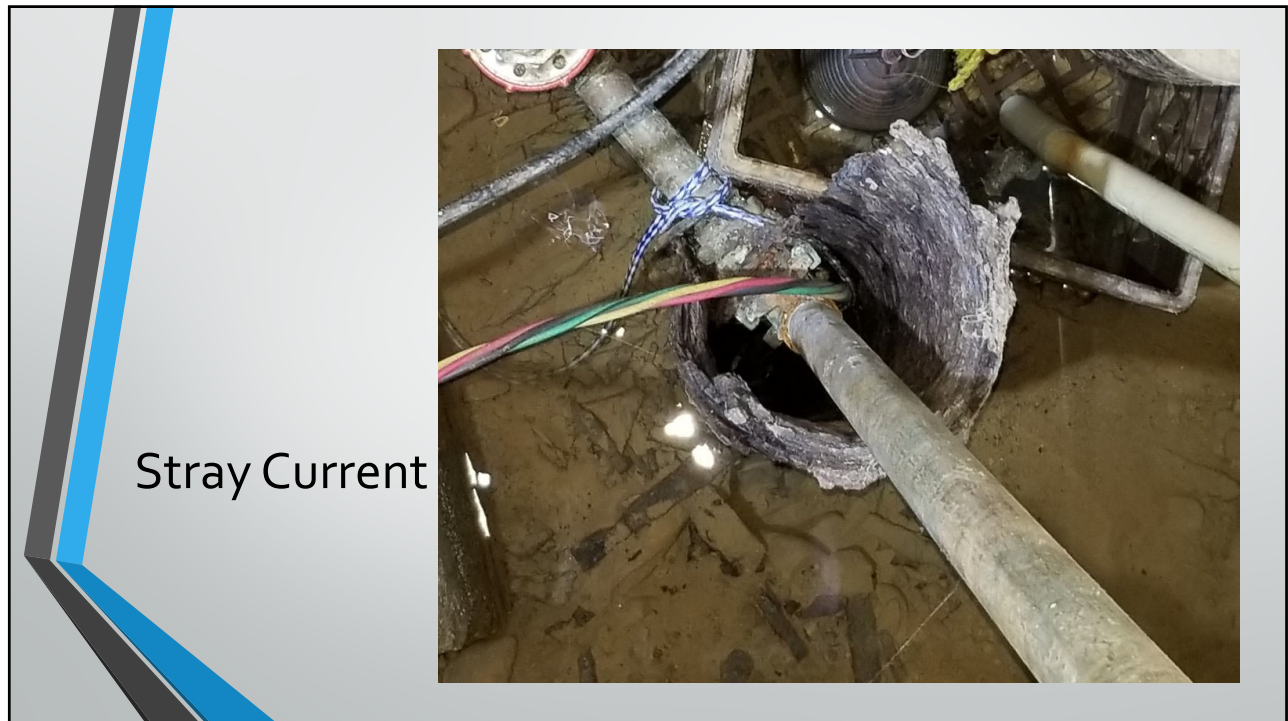
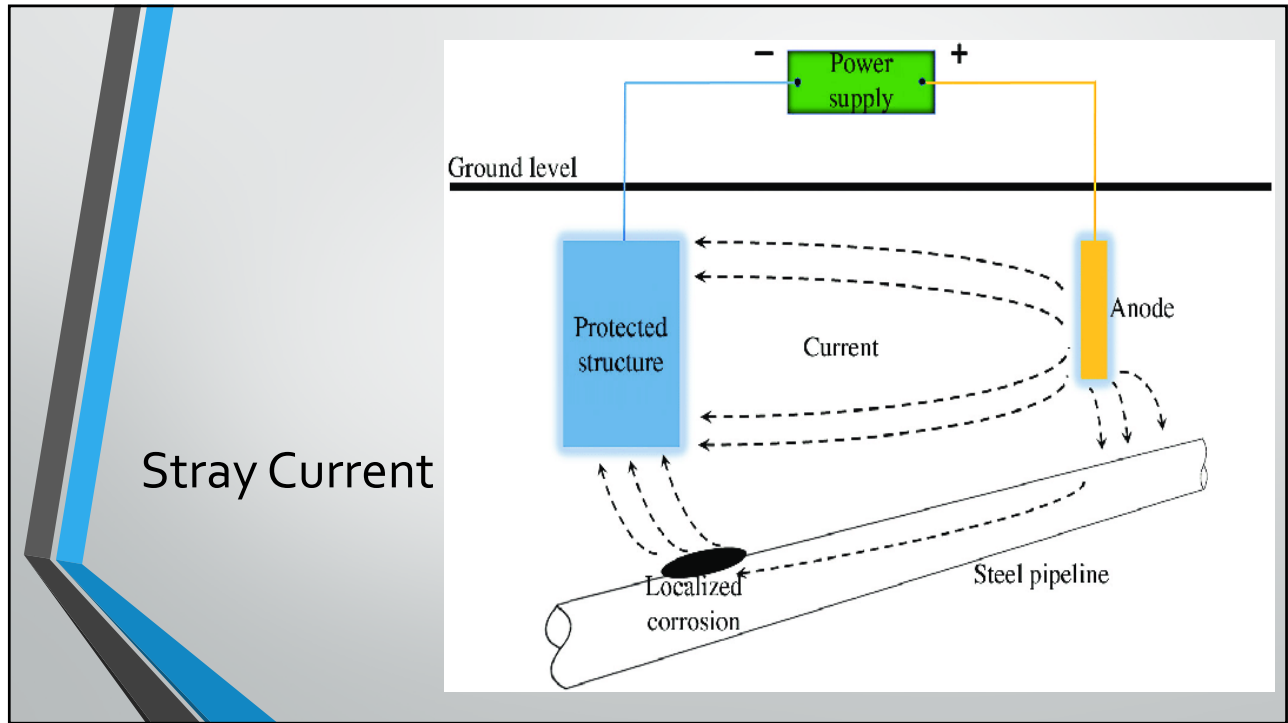
use #8 Bare copper wire to jumper any breaks in the piping

look for sealing gaskets-may be hiding in the fitting

Bonds not designed for real current just to balance accidental voltage

Stray Current





Dissolved Gasses

Difference between dissolved and free gasses

Corrosion usually occurs topside in the pipes

Easily confused with other forms of corrosion

CO₂-Oxygen H₂S the biggest culprits

Use some type of deaeration device:

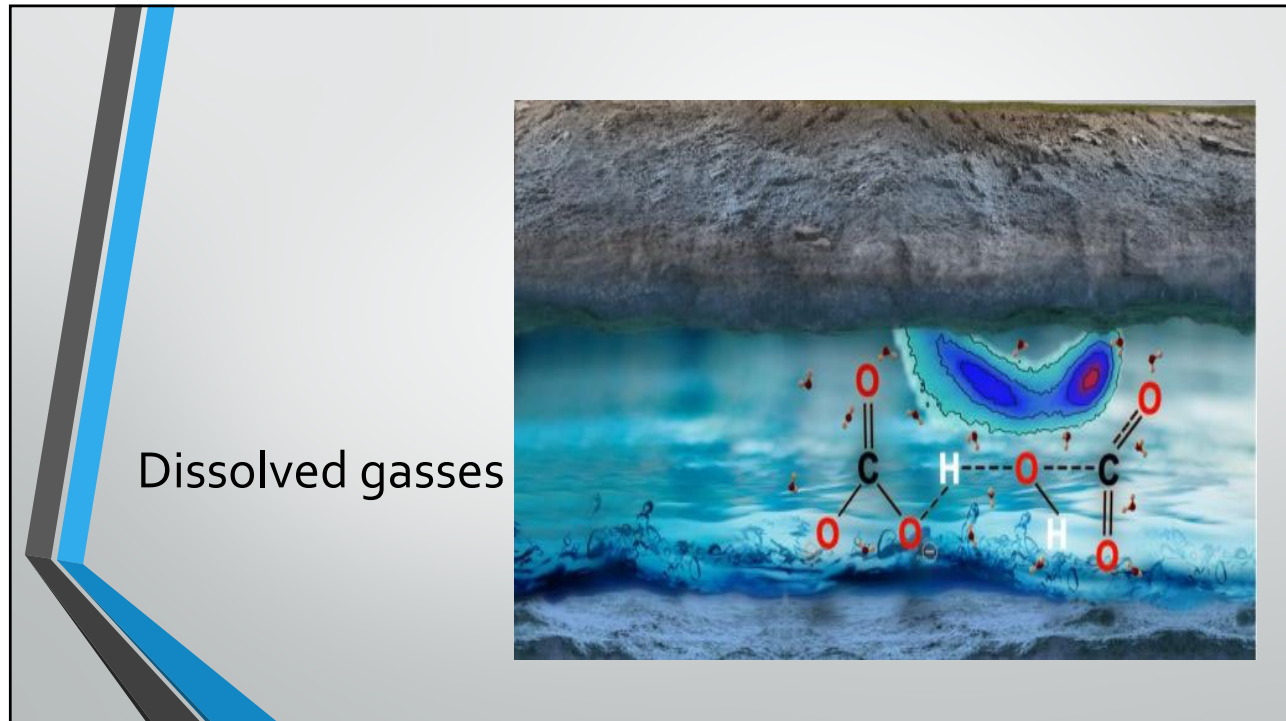
Open air tanks and repressuration

Nozzle or microbubble device

Use air collection and release valve

Dissolved Gasses





Ways to Stop Corrosion

Practice good plumbing

Avoid Stagnant sections

Avoid dead ends

Minimize direction changes and size line changes

Jumper wire valves and all plastic pipe in metal lines

Use good joining methods (solder, flux deburr, etc.)

Ways to stop Corrosion

Determine cause of Corrosion

General water test

PH,

Alkalinity,

Hardness

Temperature

TDS

CO₂ DO

Voltage & Grounding issues

Volocity of water flow

FIX PROBLEM

Ways to stop Corrossion

- Use polymers to line or treat the water
- Use PH adjustment technologys
- Remove Dissolved gasses
- Promote proper grounding
- Reduce water temperature
- Reduce fluid speed through pipes (Less than 4-7 ft per second)
- Use less fitting and line size changes
- Prevent electrical currents in pipes
- Avoid stagnant sections
- Use approved fluxes, proper deburring etc.

We have Discussed

- What is corrossion
- Some of its different forms
- Why corrossion is bad
- How to deal with some corrosion
- Learned how to recognize various forms

Questions or Answers

THANK-YOU!

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