Myths, Facts, and Common Issues of Septic Pumping

💩 Trials and Tribulations of Turd Tanks 💩

*The content views expressed in this presentation are the presenter's and do not represent the entities or organizations hosting this presentation.

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Who Are Your Presenters?

- **Ron Naumann**
  - Director of Technical Support
  - National Precast Concrete Association (NPCA)
  - Wastewater Education 501(c)3
- **Casey Fiedler**
  - Michigan Septic, LLC
  - Michigan Septic Trade Association (MSTA)
  - Wastewater Education 501(c)3
  - National Association Wastewater Technicians (NAWT)

Why Are There So Many Misconceptions?

- Compartmentalized industry historically
- Segments groups and associations around the county and world
- Vast differences in education and training requirements by region
- Huge range of requirements and legislation by region
- Advancement in the application of research and objective outlooks to the industry in the last few decades

What are some myths you've heard?

"Toss a dead _____ in there for bacteria!"

Add a gallon of spoiled milk once a month.

Tanks never need pumping if they're working right!

Myth: Only Pump if There's a Backup

- Problem: backups and signs of struggling systems are a lagging indicator
- *"My neighbor says you don't have to pump if it's working properly!"*

- Remember that not all backups indicate failure, though
- Look for:
  - Clogged filter
  - Clogged inlet
  - Operating level
  - Runback

Myth: Pump Every 3-5

- Better than not pumping often enough!
- There's nothing wrong with using it as a catchy reminder jingle
- There is wide disagreement on average sludge and scum accumulation even among reputable sources
- This heavily impacts assumed timeframes

Source	Gallons of Sludge and Scum Per Person Per Year
Decentralized Water Reclamation Engineering (Siegrist, 2017)	12 gal/cap/yr
Decentralized Water Reclamation Engineering (Siegrist, 2017)	30 gal/cap/yr
Penn State (https://extension.psu.edu/septic-tank-pumping)	60 gal/cap/yr

Note: Siegrist presents a range of possible values from the "average rate" of 12-15 gal/cap/yr up to the 95% confidence interval of 24-30 gal/cap/yr.

Myth: Additives Replace Pumping

- A constant debate, often misunderstood by homeowners
- Independent studies repeatedly find no, or extremely little, consistent evidence to indicate additives reliably improve wastewater characteristics in onsite septic systems
- Try to help educate and inform your clients
- Most information shows little downside to common additives other than, perhaps wasted money

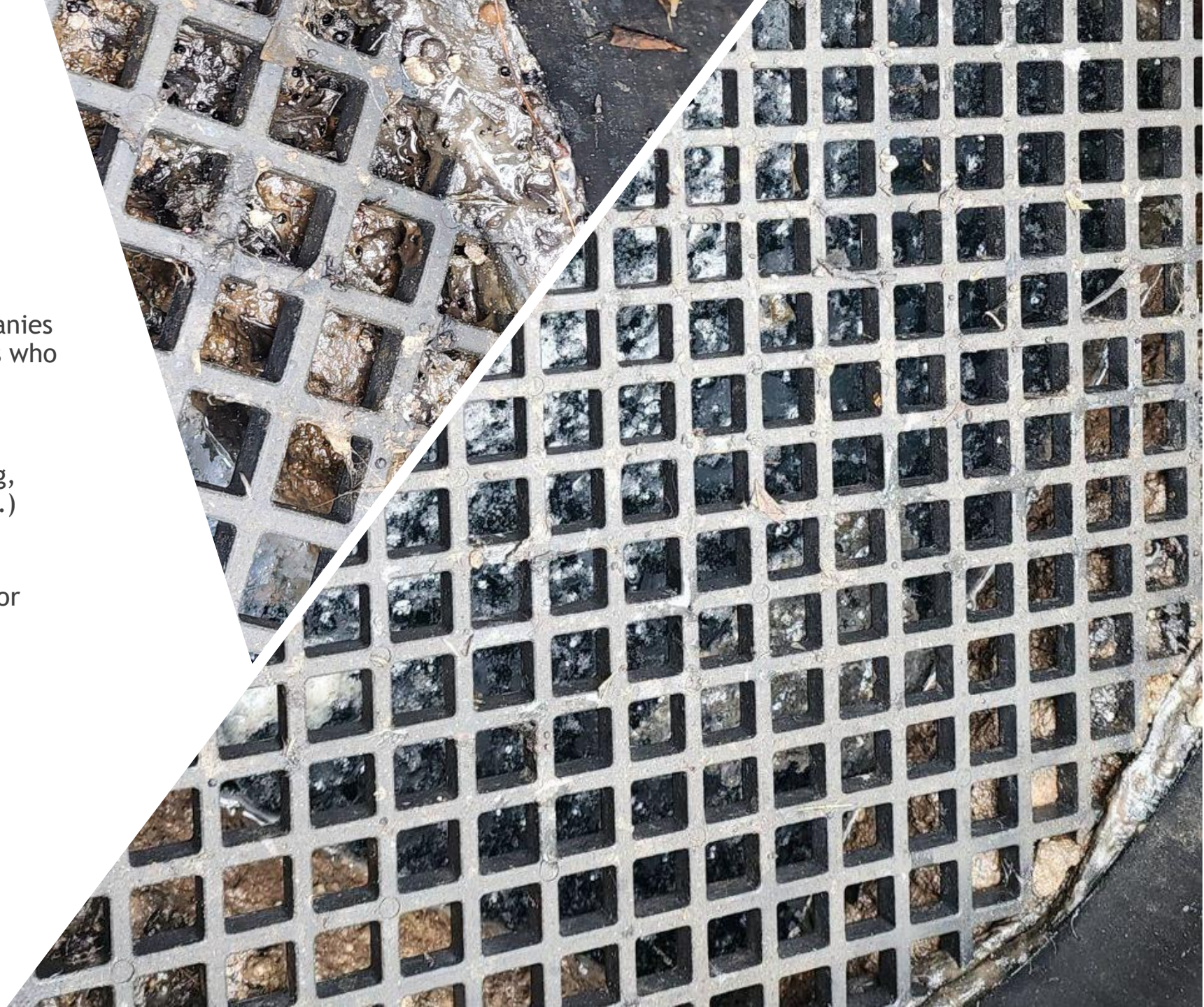
Issue… Environmental Challenges

- Insects (bees in control panels, valve boxes, etc.)
  - Other pests or creatures
- Hard soils (nearly impossible to dig lids)
  - Dry soils
  - Frozen soils

- Issues may vary dramatically by region – what unusual challenges do you face?

Issue…
Riser Retrofits

- Risers are often installed by companies cutting corners or property owners who don’t know any better.
- Check for proper seal (adapter ring, high quality hydraulic cement, etc.)
- Risers should be watertight, look for signs of leakage in or out



Issue…
Homemade Tank Lids

This old door used as a lid is extremely dangerous!

Segmented lids can be dubious at best

Replacing tank lids or sections with non-standard materials is highly inadvisable and could even be dangerous!

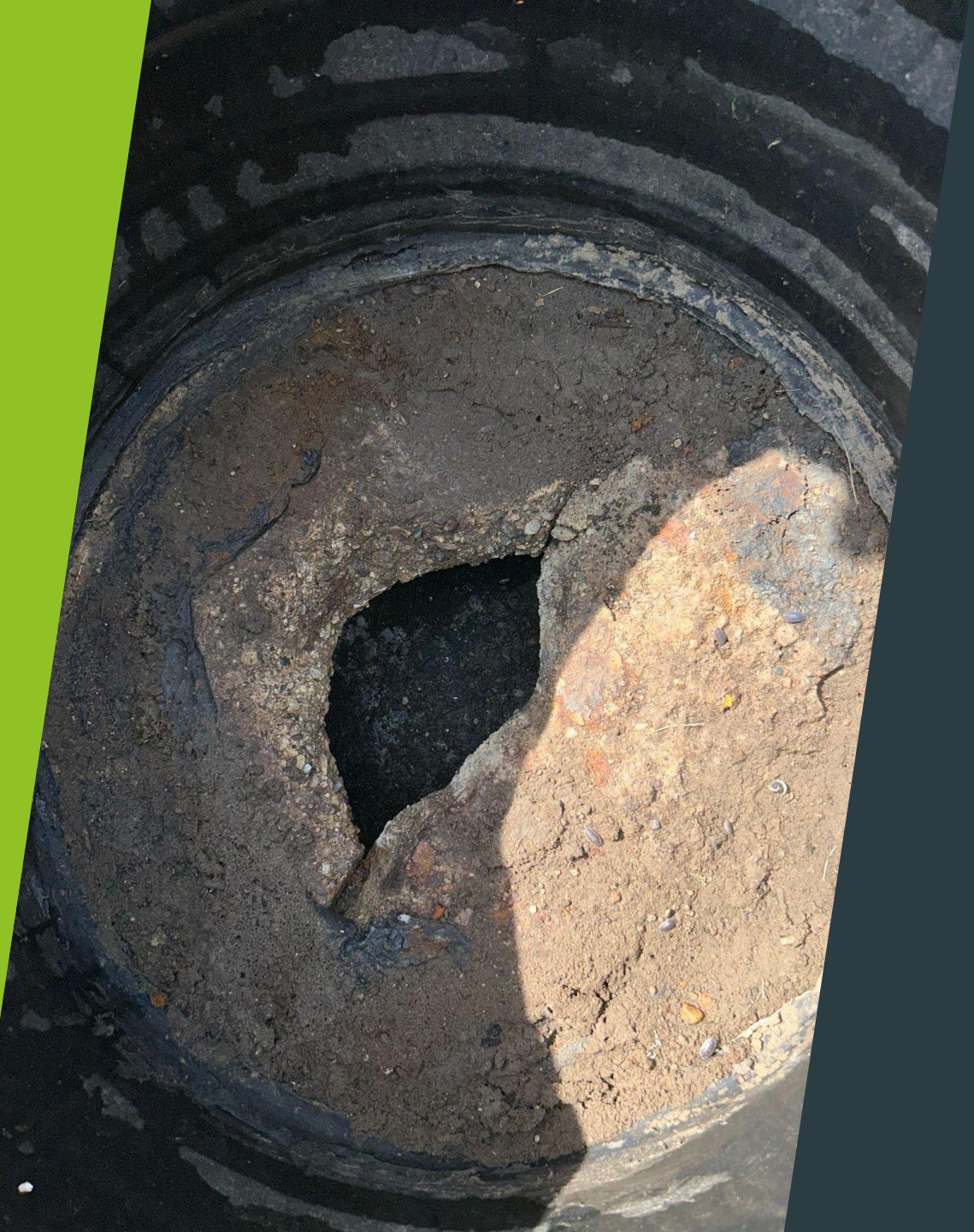
Issue…
Tank Location Curveballs

- You can never have too many tools on the truck…
- When do you charge extra?
- When should you just say “no” to digging?
- Remember to set expectations…
  - Will you remove landscape objects? Will you put it all back together?

Issue…
What are your policies?

- Do you dig up tanks if they’re under finished landscape?
- Tanks under decks, driveways, etc.
- Do you have a waiver or signature form that clearly explains what you charge and what you do or don’t cover?

- Without clear expectations, you may have to choose between an argument or bad review, or a follow up visit to appease the client.



Issue… Modifying Tank Access

- Is it okay to cut a new hole in the top of a tank?
- What should you do if you find someone else has cut, broken, or modified to add a tank “access” point?
- Does your area allow repairs or retrofits?

Issue…
Missing Lid Handles

A common problem!

Ideas:

Carry metal door handles and concrete screws

Or “D” rings you can bolt on

Try to find quality stainless steel that will last.

Above: customer used conduit… maybe not very sturdy…

Left: Metal d-ring anchors may allow rope or chain pulling.

Issue…
Tank Cracks and Roots

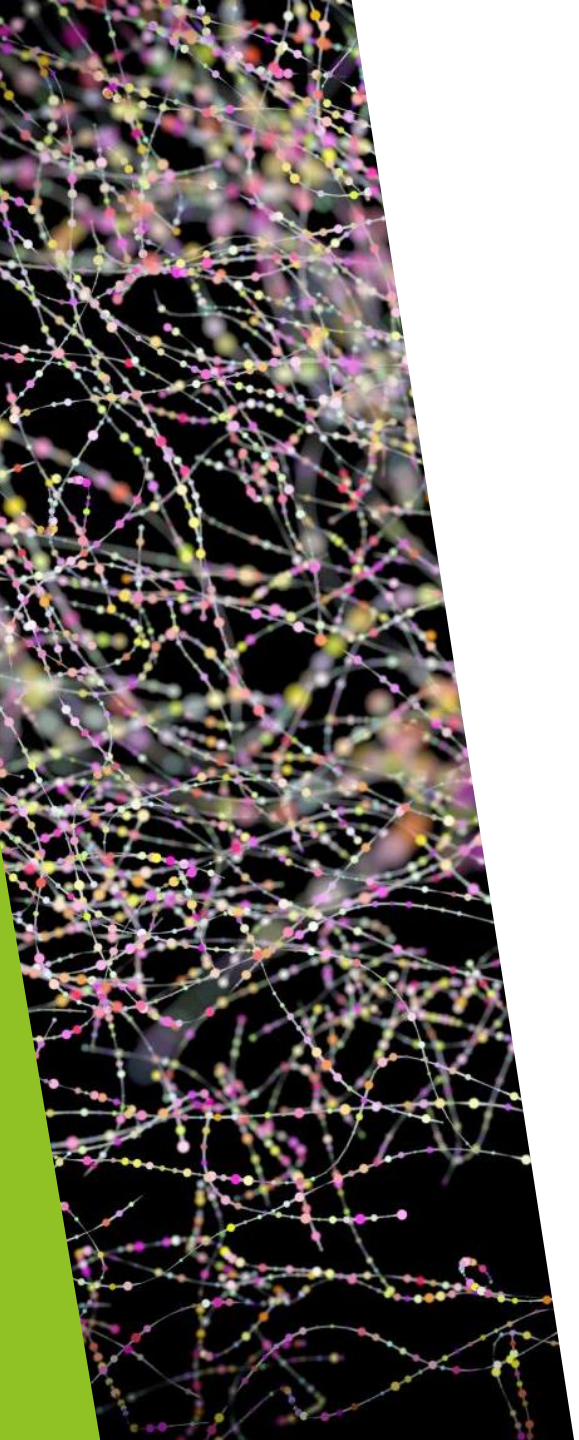
- How big of a crack is “bad”?
- Roots love to get into tanks…
  - At what point is this “bad”?
- Testing for Watertightness:
  - Hydrostatic
  - Vacuum
- Reoport objectively
  - Let state or county determine “failure”

Issue…
Riser Lids & Valve Cover Lids

- Often missing screws
- Often hit by mowers

- Carry extras!
  - Riser lids
  - Valve Covers
  - Conduit coupling
  - LPP fittings (flushing ports)
  - Etc.

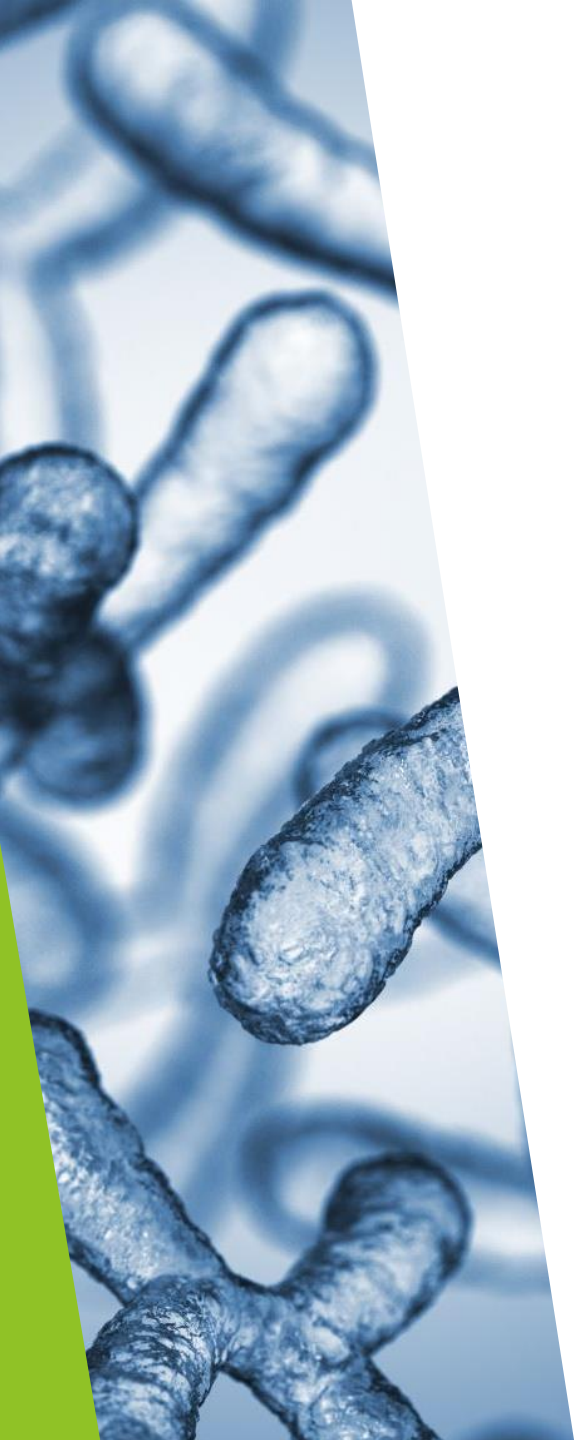
Misconception…
Concrete Take Damage Over Time



What is MICC??

- **Microbiologically Induced Corrosion (MICC):** Degradation caused or promoted by microorganisms
- **Microbial:** Relates to microorganisms. Living organisms that require magnification to see. Bacteria, Yeasts, Molds, Algea, etc
- **Corrosion:** Degradation of a material due to a reaction with its environment

Where Does it Occur?



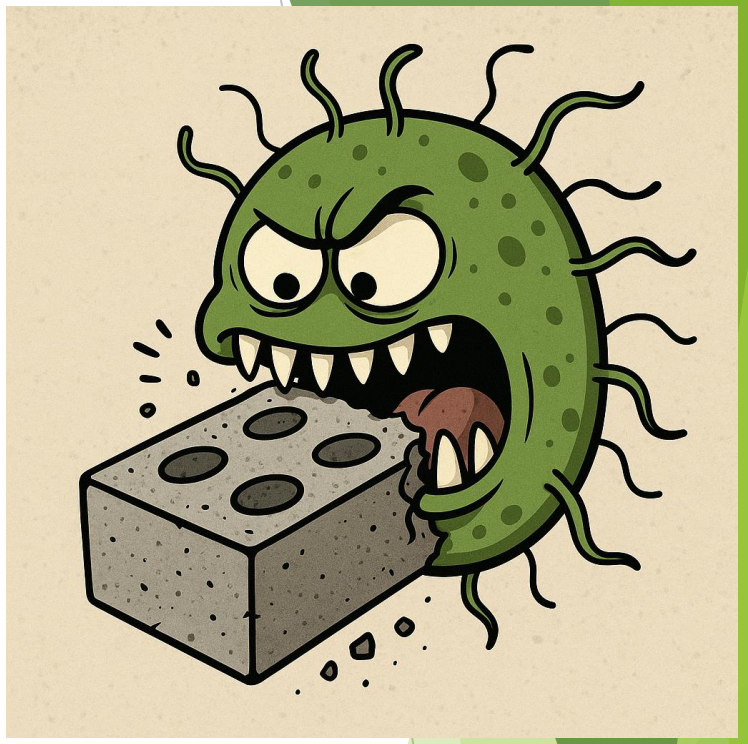
Terms

- **Microbial:** Relates to microorganisms. Living organisms that require magnification to see. Bacteria, Yeasts, Molds, Algea, etc
- **Corrosion:** Degradation of a material due to a reaction with its environment
- **Microbiologically Induced Corrosion (MIC):** Degradation caused or promoted by microorganisms

Precast Concrete Occurrences

How Does It Appear?

Common Myths



- ~~The bacteria eats concrete~~ **No!**
- ~~The H_2S gas corrodes the concrete~~ **No!**
- ~~Acid in the water gets on concrete~~ **No!**
- ~~MIC is rampant~~ **No!**

~~"When the hydrogen sulfide gas mixes with water vapor and low levels of oxygen they form sulfuric acid"~~

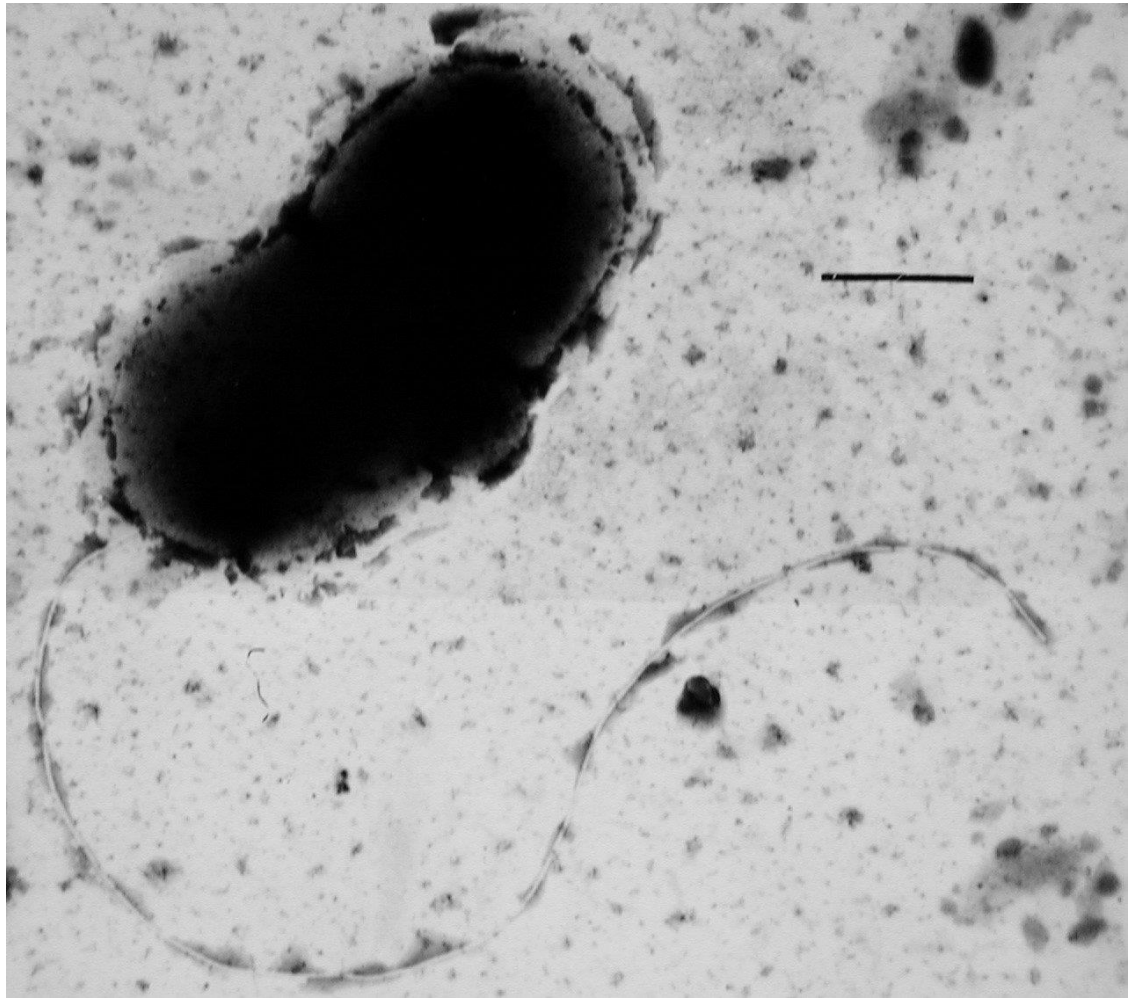
No!

What is H_2S?

- Colorless Gas
- Breakdown of Organic Matter
- Dangerous
- Food source for
- bacteria

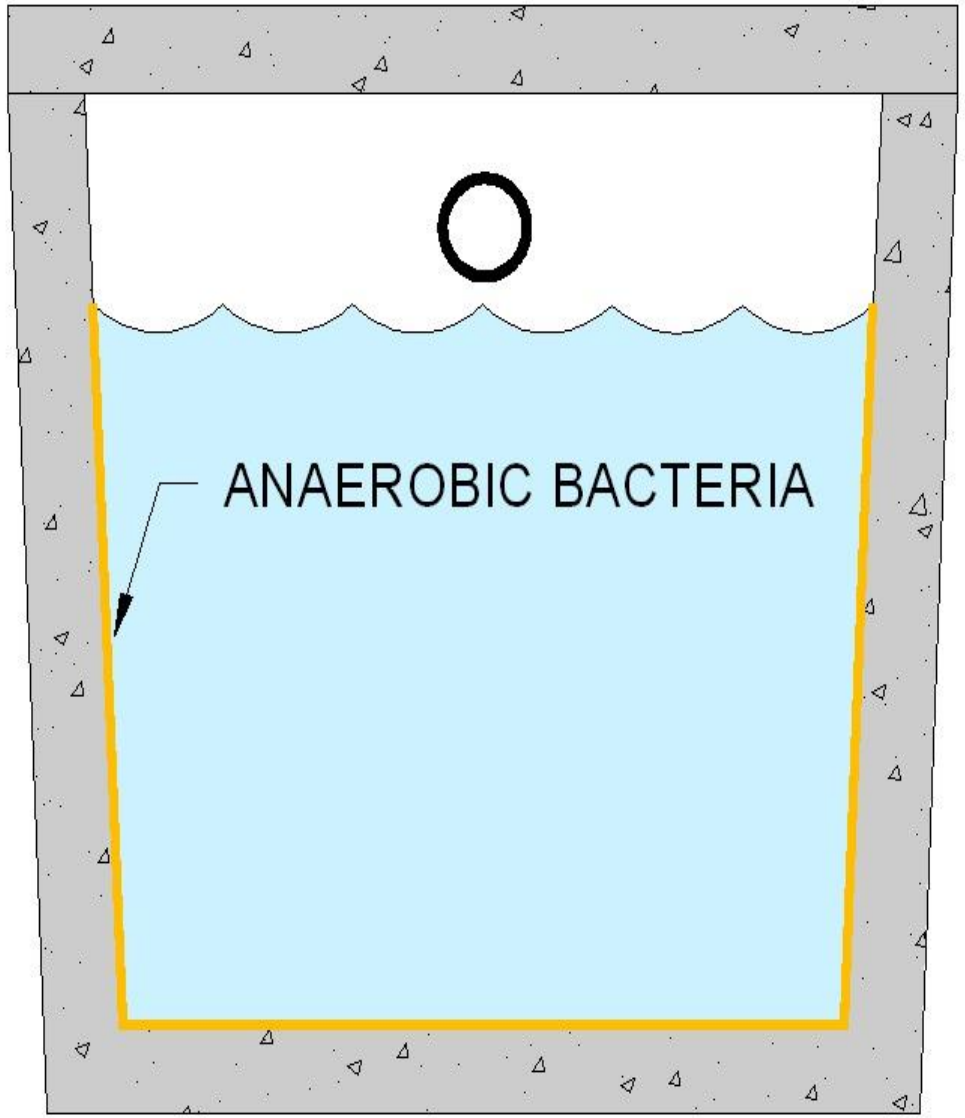
Concentration (ppm)	Symptoms/Effects
0.00011-0.00033	Typical background concentrations
0.01-1.5	Odor threshold (when rotten egg smell is first noticeable to some). Odor becomes more offensive at 3-5 ppm. Above 30 ppm, odor described as sweet or sickeningly sweet.
2-5	Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep. Airway problems (bronchial constriction) in some asthma patients.
20	Possible fatigue, loss of appetite, headache, irritability, poor memory, dizziness.
50-100	Slight conjunctivitis ("gas eye") and respiratory tract irritation after 1 hour. May cause digestive upset and loss of appetite.
100	Coughing, eye irritation, loss of smell after 2-15 minutes (olfactory fatigue). Altered breathing, drowsiness after 15-30 minutes. Throat irritation after 1 hour. Gradual increase in severity of symptoms over several hours. Death may occur after 48 hours.
100-150	Loss of smell (olfactory fatigue or paralysis).
200-300	Marked conjunctivitis and respiratory tract irritation after 1 hour. Pulmonary edema may occur from prolonged exposure.
500-700	Staggering, collapse in 5 minutes. Serious damage to the eyes in 30 minutes. Death after 30-60 minutes.
700-1000	Rapid unconsciousness, "knockdown" or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.
1000-2000	Nearly instant death

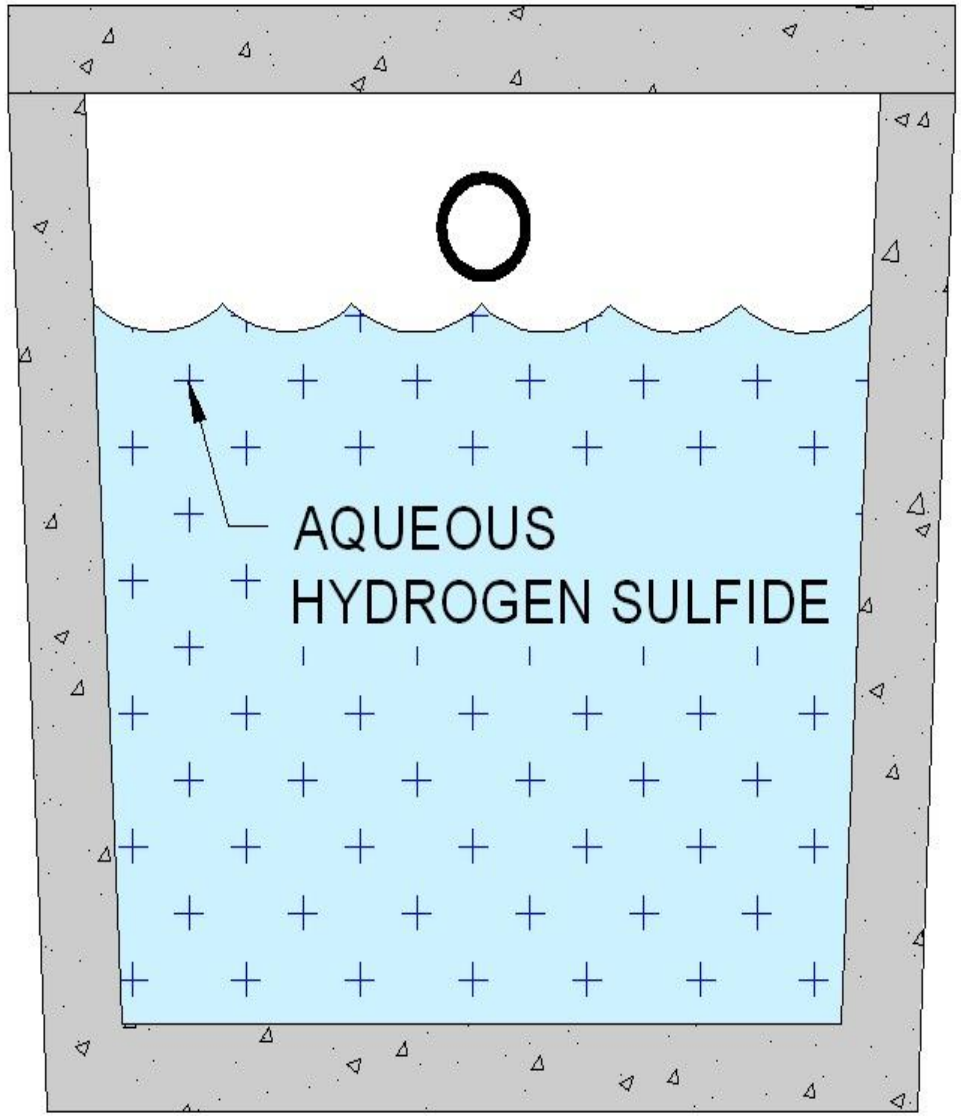
Anaerobic Bacteria



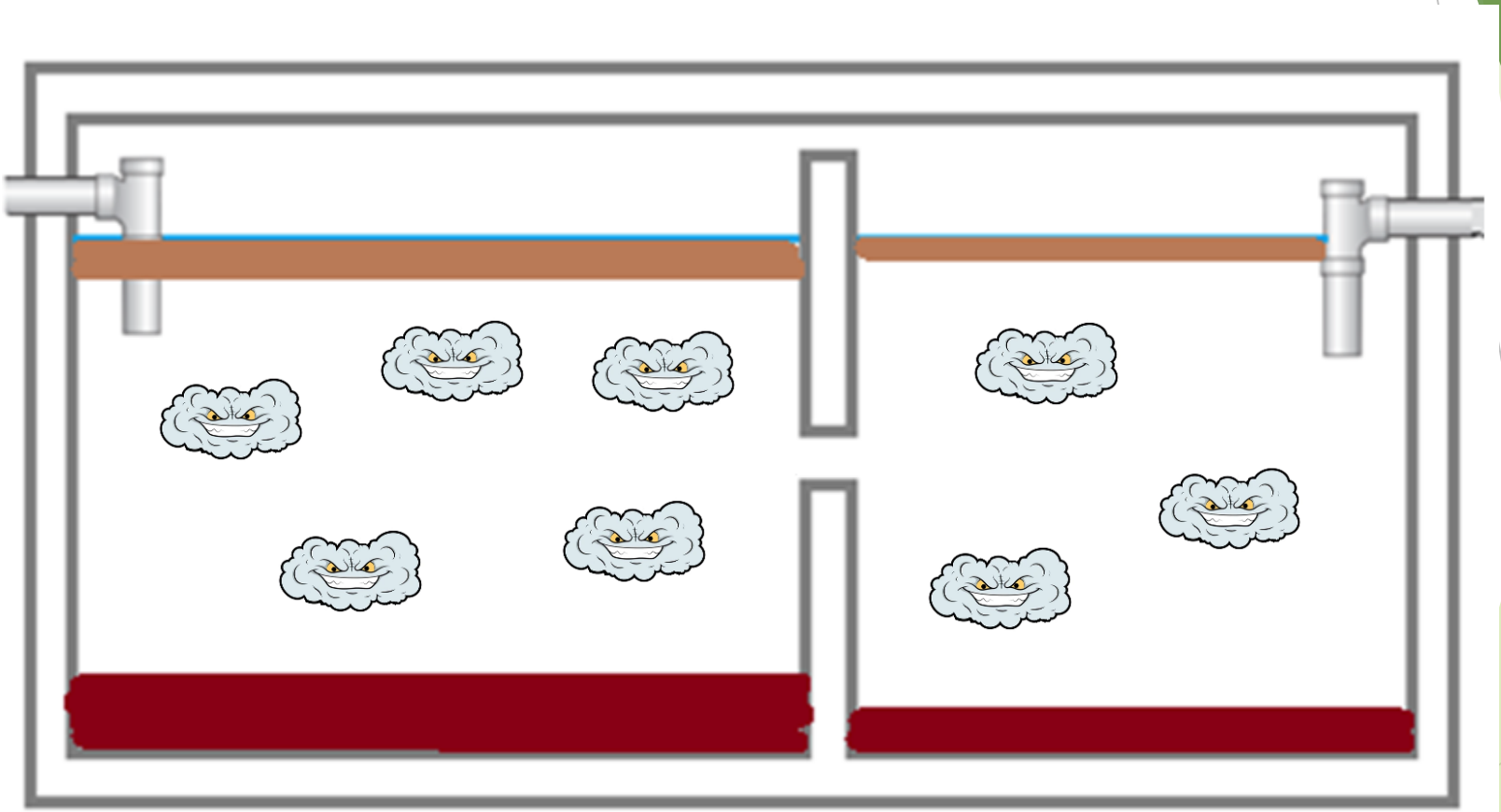
Sulfate Reducing Bacteria (SRB)

- Anaerobic
- Uses sulfates as oxygen source
- Some are tolerant of oxygen


ANAEROBIC BACTERIA


AQUEOUS
HYDROGEN SULFIDE

$H_2S_{(aq)}$ trying to get to $H_2S_{(gas)}$



H_2S Gas Release

Factors influencing release of H_2S gas from aqueous phase:

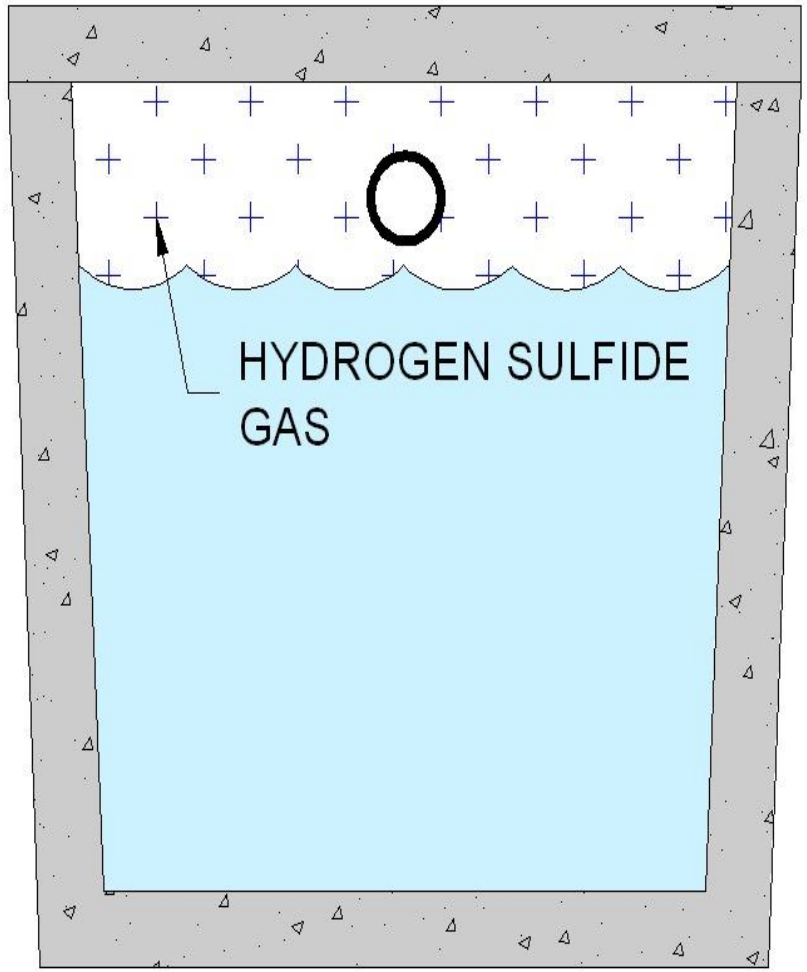
Wastwater pH: Low pH encourages formation of sulfides that can then become aqueous hydrogen sulfide

Concentration: Higher concentrations of H_2S (aq) encourage release of H_2S (gas) into the headspace

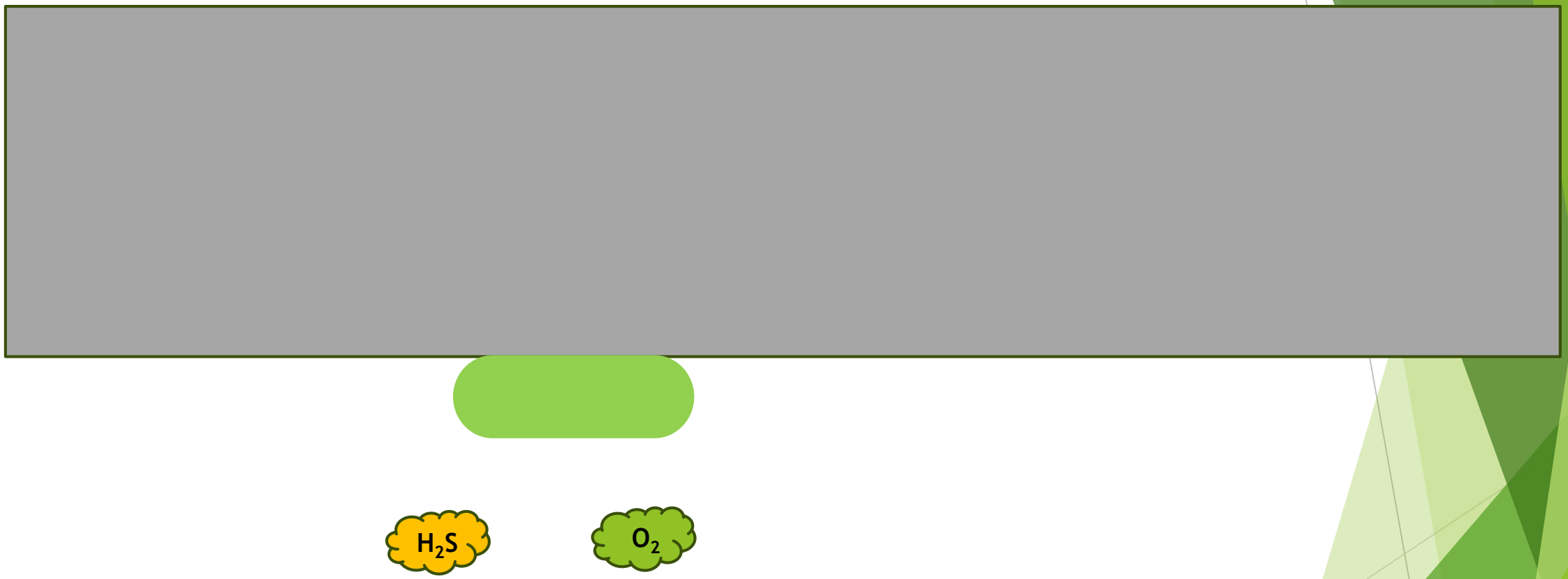
Temperature: Higher temperatures increase release of H_2S gas.

Turbulence: High turbulence increases liquid-gas surface area for H_2S to partition into gas phase

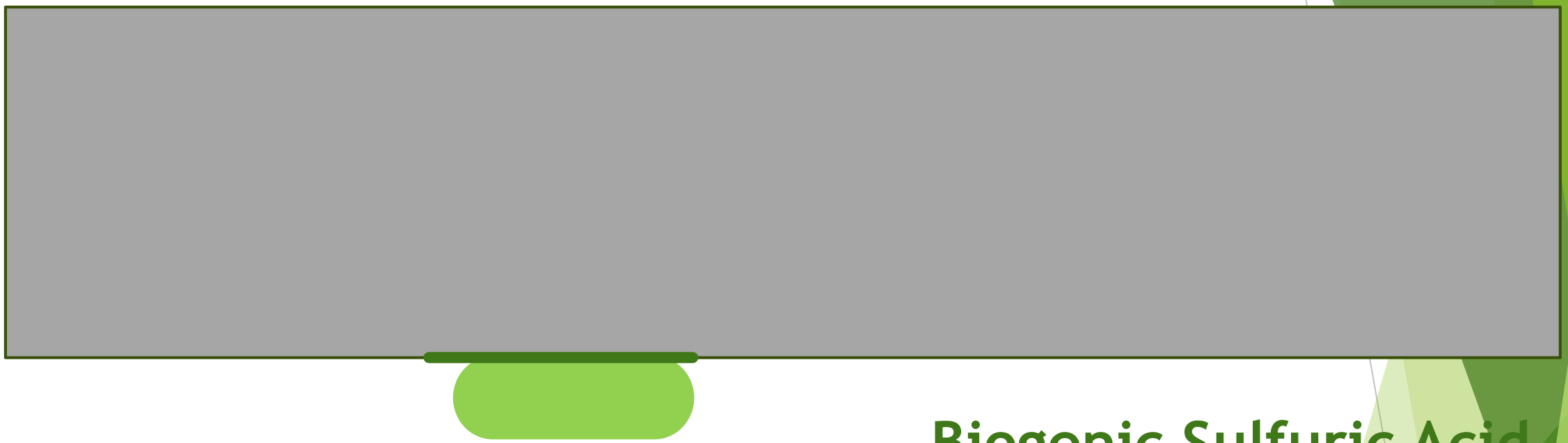
House, 2013


HYDROGEN SULFIDE
GAS

Sulfate Oxidizing Bacteria

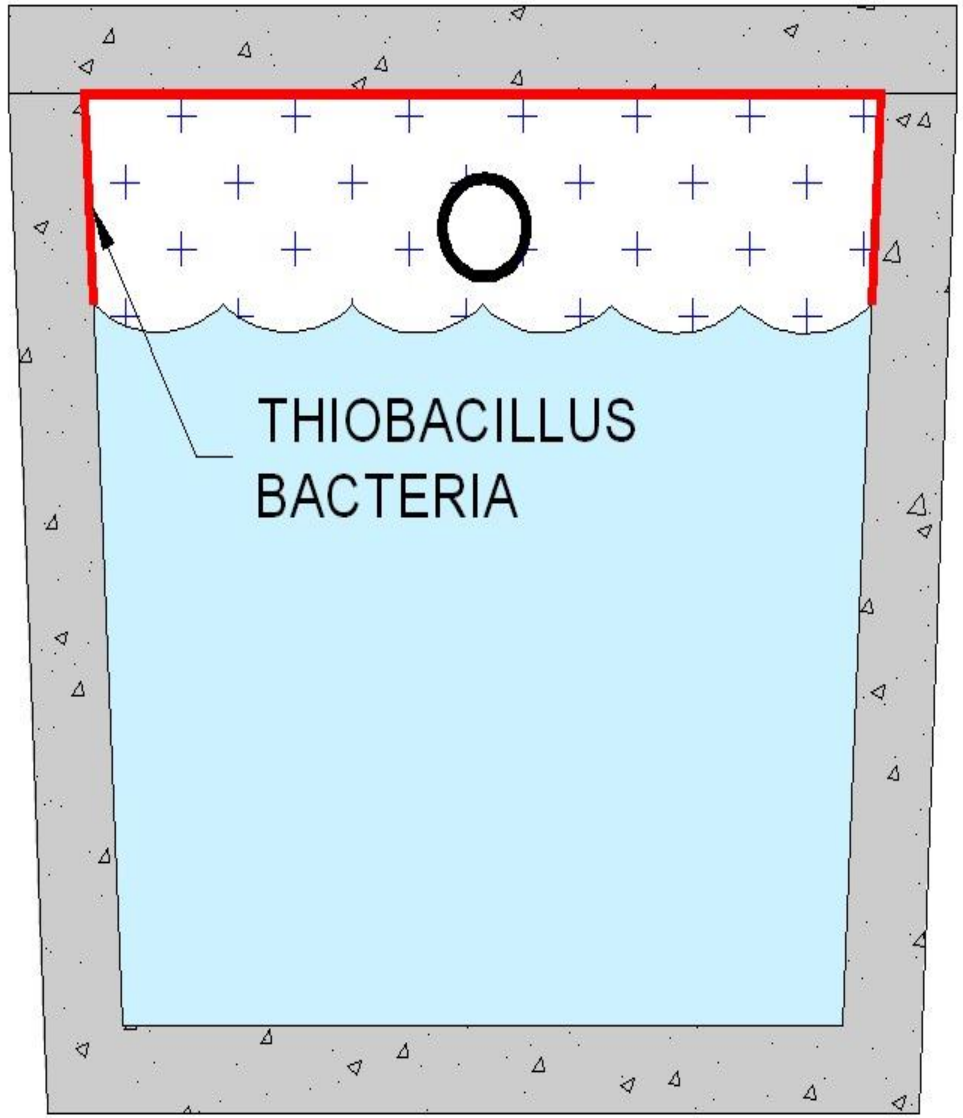


Sulfate Oxidizing Bacteria



Biogenic Sulfuric Acid

Reacts with paste components
first decalcifying
Calcium Hydroxide (CH)
forming gypsum and ettringite


THIOBACILLUS
BACTERIA

Sulfate Oxidizing Bacteria (SOB)

- Thiobacillus
- Aerobic
- Thrives in pH below 9

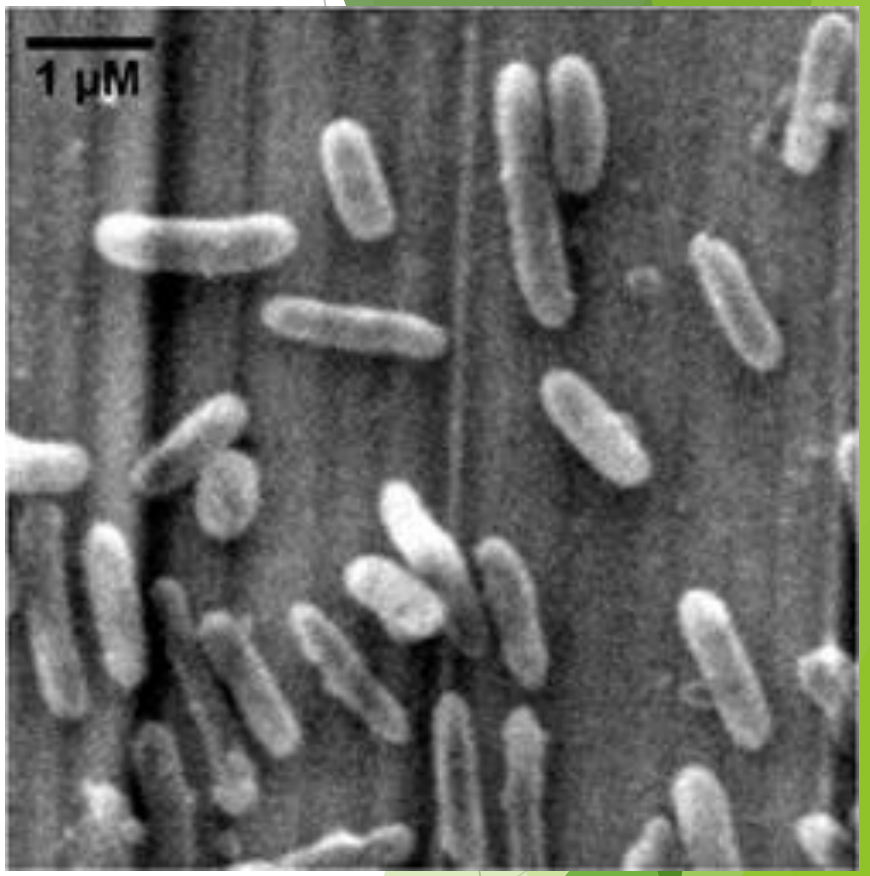


Table 2. Preferred substrates and pH ranges for SOM involved with MIC in concrete sewer networks (Islander et al., 1991, Madigan, 2006)

Species	Preferred Substrate	Preferred pH Growth Range
T. thioparus	H_2S, S^0, $S_2CO_3^{2-}$	5-9
T. novellus	$S_2CO_3^{2-}$	2.5-8
T. intermedius	$S_2CO_3^{2-}$	2.5-8
T. neapolitanus	S^0, $S_2CO_3^{2-}$	3-7
T. thiooxidans	H_2S , S^0	0.5-3

Source: Review of Microbially Induced Corrosion and Comments on Needs Related to Testing Procedures - M. W. House and W. J. Weiss

MICC Research by NPCA

1. **Purdue University -** Using Biological and Physico-Chemical Test Methods to Assess the Role of Concrete Mixture Design in Resistance to Microbially Induced Corrosion – House, 2013
2. **University of Wisconsin – Stevens Point -** Investigating the Potential for Septic System Modifications to Reduce Microbial Induced Corrosion of Concrete – Keymer and Stange – 2020
3. **MIC Modifications LLC -** Investigating the Mitigation of Hydrogen Sulfide Emissions Associated with Septic System Modifications to Reduce Microbial Induced Corrosion of Concrete - Keymer and Stange – 2024

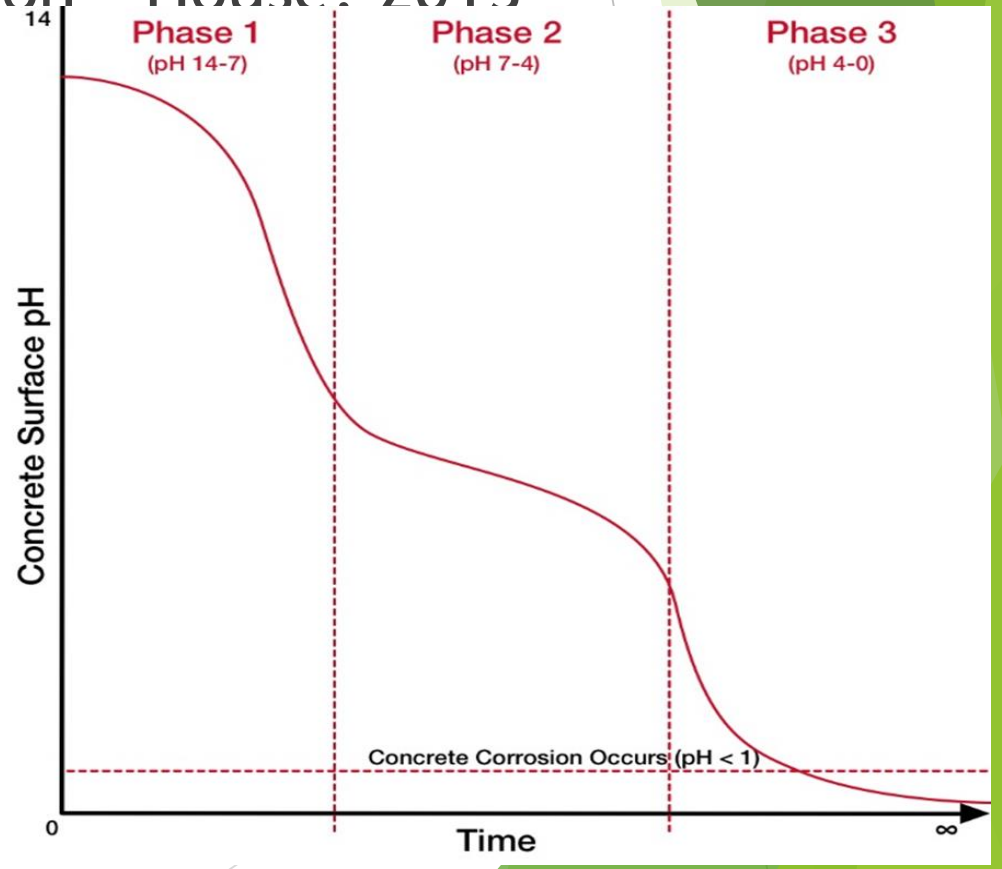
MICC Research by NPCA

Purdue University - Using Biological and Physico-Chemical Test Methods to Assess the Role of Concrete Mixture Design in Resistance to Microbially Induced Corrosion - House, 2013

Replicated conditions in a lab

Clearer picture of the MICC Process

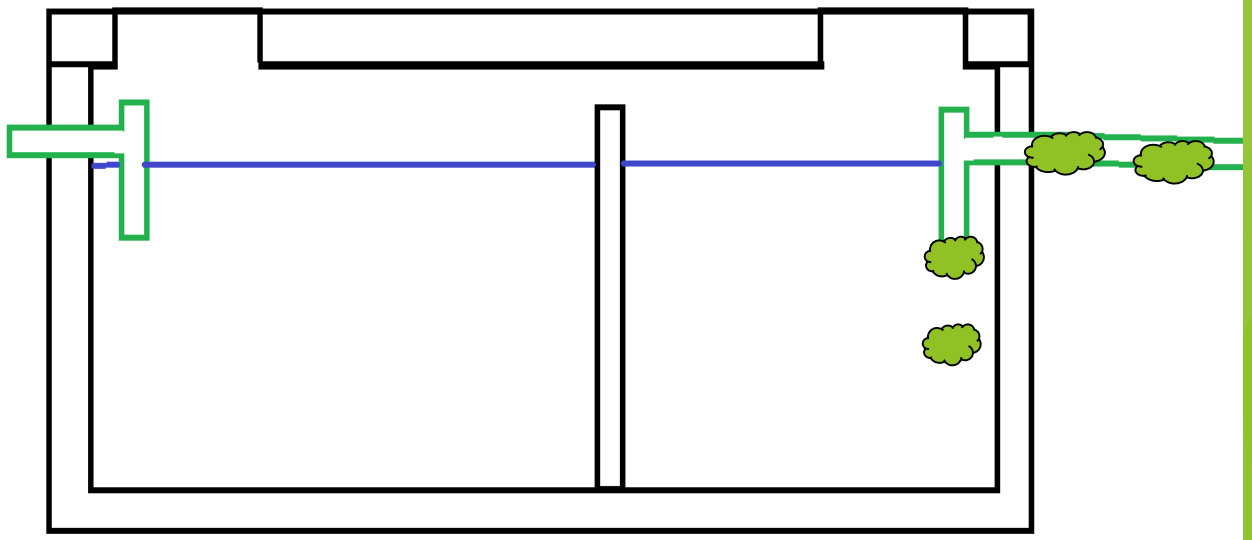
Confirmation of 3 stages.



MICC Research by NPCA

University of Wisconsin – Stevens Point - Investigating the Potential for Septic System Modifications to Reduce Microbial Induced Corrosion of Concrete – Keymer and Stange – 2020

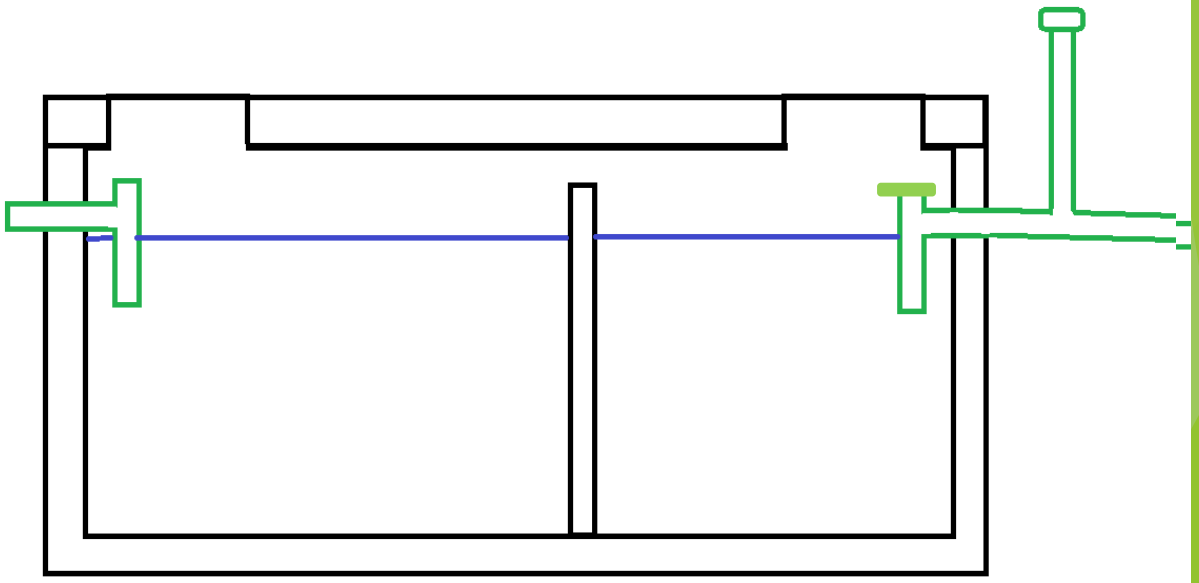
Studied H_2S gas accumulation in actual septic systems experiencing MICC and the effect of different venting configurations.



MICC Research by NPCA

University of Wisconsin – Stevens Point - Investigating the Potential for Septic System Modifications to Reduce Microbial Induced Corrosion of Concrete – Keymer and Stange – 2020

Found that redirecting gases from top of effluent tee significantly reduces H_2S gas in septic tank.



MICC Mitigation - Coatings

Coatings used to protect against MICC

- Epoxies (High build, high performance)
- Polyurethanes (high build)
- Polyureas
- Cementitious (Calcium Aluminate Cements)
- Elastomeric
- Immersion
- Good Adhesion & Strength
- High Solids Content Waterproofing Membrane
- Primer

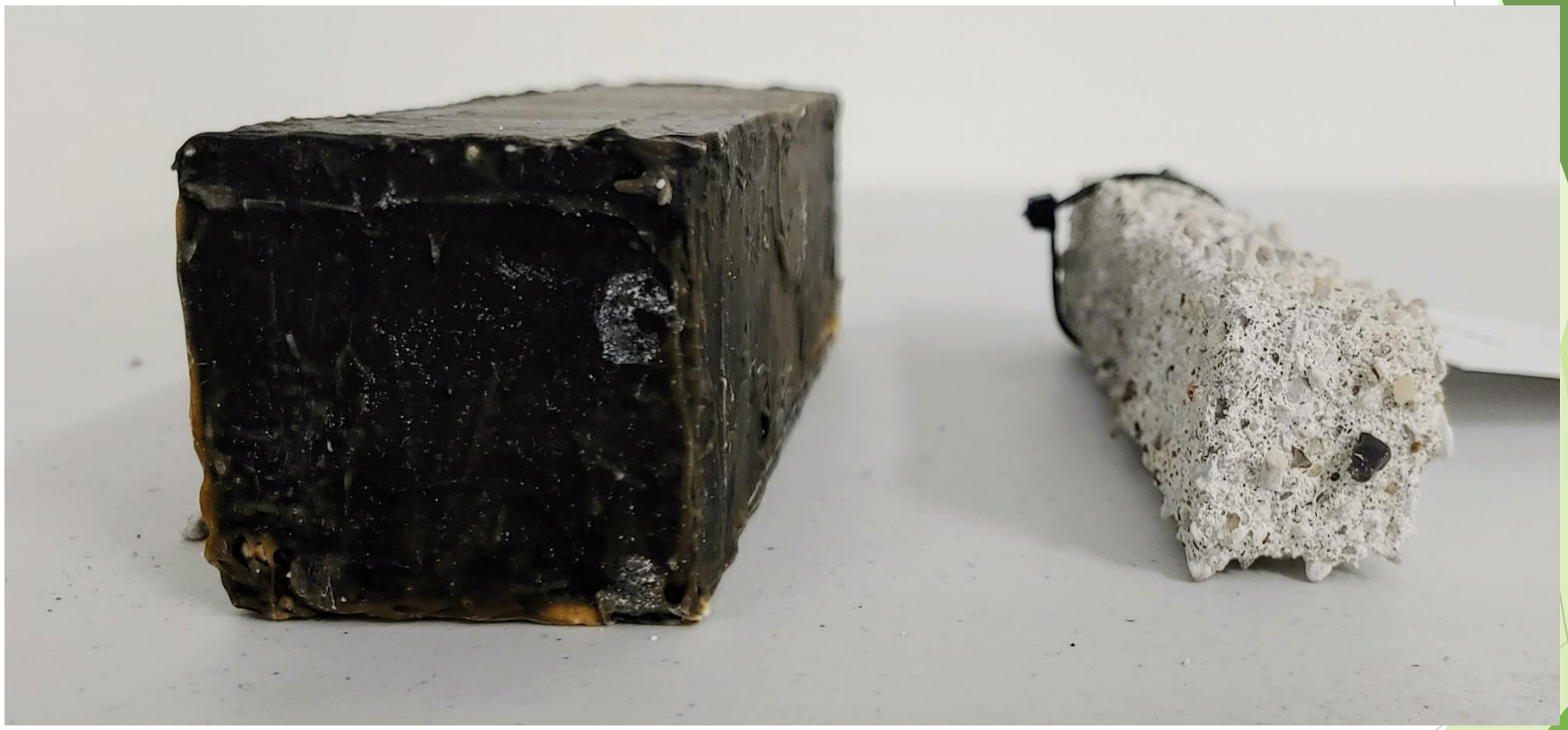
ASTM C836

ASTM C1898

MICC Mitigation - Coatings

ASTM C1898-20

After 12 weeks of immersion in SULFURIC ACID (0.5 pH)



NO MASS LOSS

77% MASS LOSS

MICC Mitigation - Sealers

- Sealers are thin films or penetrants that change the surface characteristics of concrete. Sealers can be water repellents, pore blockers, antimicrobials, or any combination thereof.

- Generally, sealers would be used to prevent bacteria from attaching to the concrete. (Phase 2).

  Not for acid resistance (Phase 3)

ASTM C1585 - Standard Test Method for Measurement of Rate of Absorption of Water by Hydraulic-Cement Concretes

ASTM C1904 - Standard Test Methods for Determination of the Effects of Biogenic Acidification on Concrete Antimicrobial Additives and/or Concrete Products

MICC Mitigation - Sealers

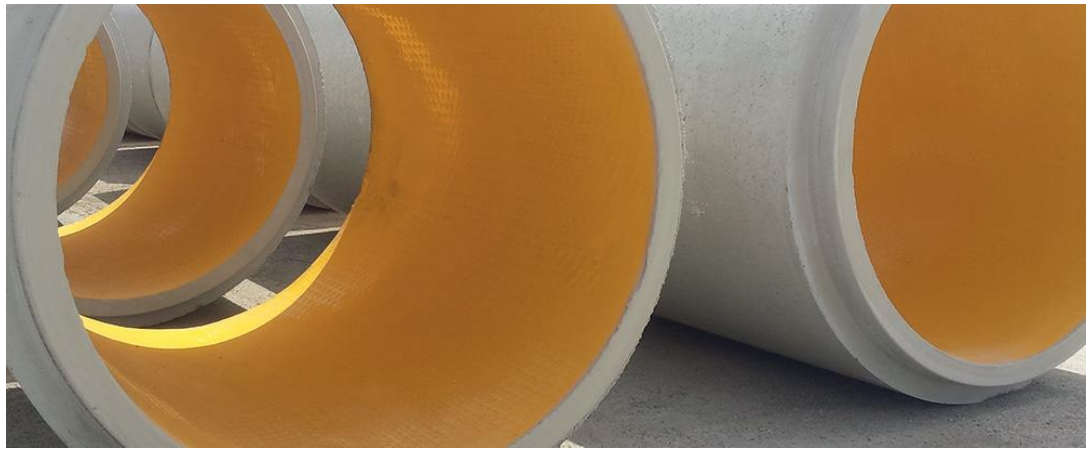
- Brush, trowel, roller or spray applied.

MICC Mitigation - Liners

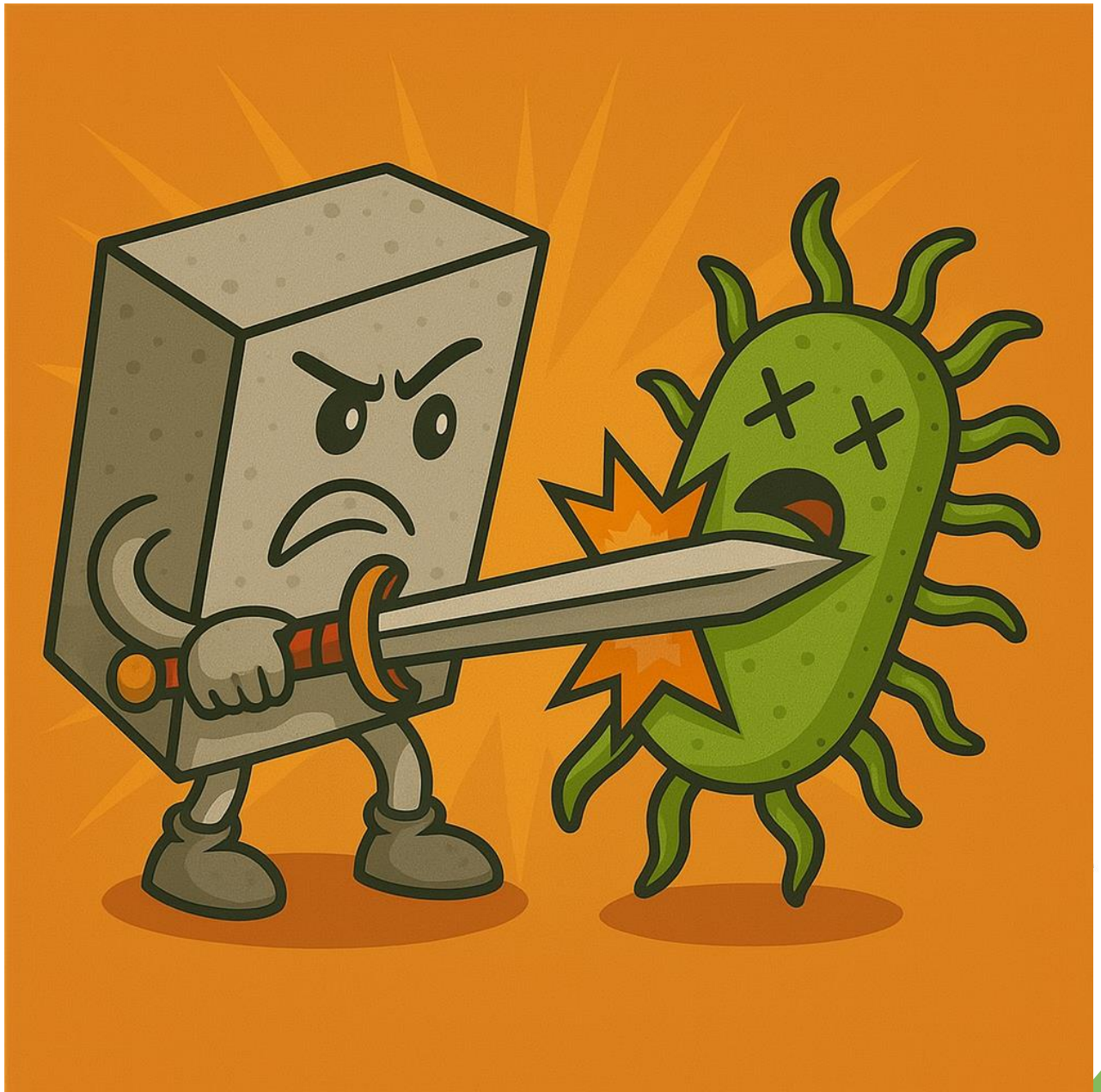
Concrete Protective Liners (CPLs) are thermoplastic membranes that act as a barrier to prevent damage from harsh chemicals such as MICC derived sulfuric acid.

- Polyethylene (PE or HDPE)
- Polypropylene (PP)
- Polyvinyl Chloride (PVC)
- Other resins depending on the chemical resistance requirements beyond that of a typical municipal wastewater stream.

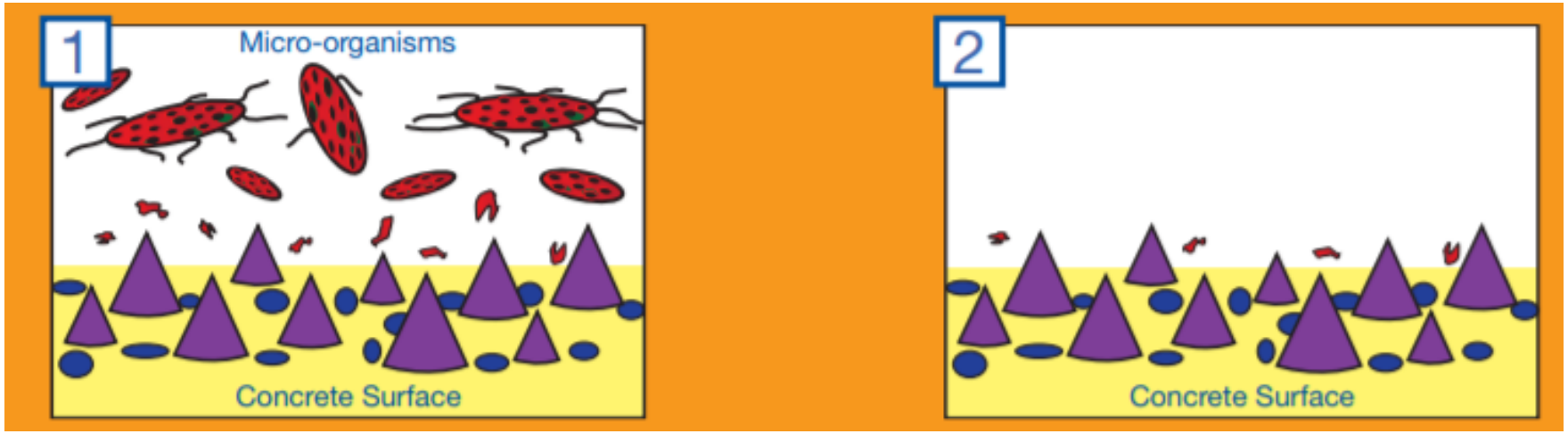
ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents



Antimicrobial Admixtures



Antimicrobial Admixtures



ASTM C13.03 Subcommittee on Determining the Effects of Biogenic

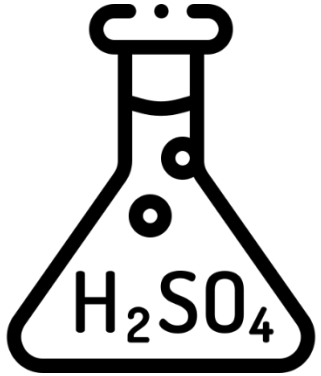
Sulfuric Acid on Concrete Pipe and Structures

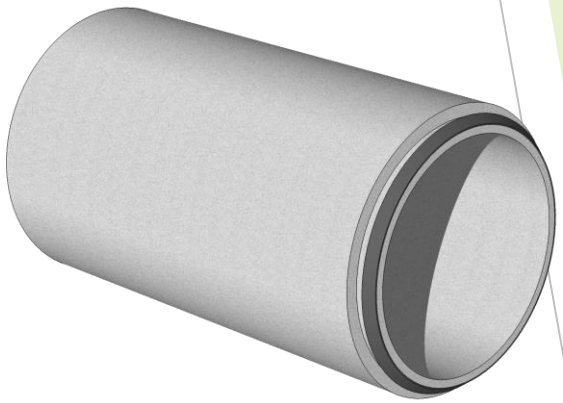
- **C1894-22** Guide for Microbially Induced Corrosion of Concrete
- **C1904-22** Standard Test Methods for Determination of the Effects of Biogenic Acidification on Concrete Antimicrobial Additives and/or Concrete Products
  - Test Method to:
    - Measuring the efficiency of an additive in neutralizing bacteria in solution.
    - Measuring the bacterial activity and effectiveness of anti-microbial additives in concrete.
    - Measuring the presence and dosage of anti-microbial additives in concrete.
- **C1898-20** Standard Test Methods for Determining the Chemical Resistance of Concrete Products to Acid Attack
  - Creating new acid immersion test

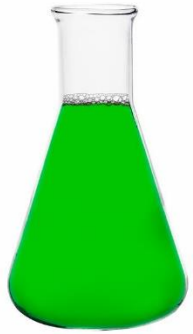
ASTM C1904

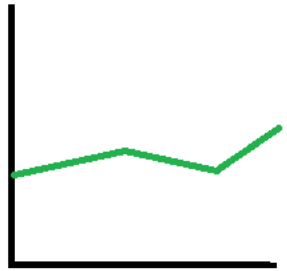
Two Main Uses

1. Determining effects of biogenic acidification on concrete products
2. Determining efficacy of antimicrobial products to resist microbially-induced concrete corrosion (MICC)



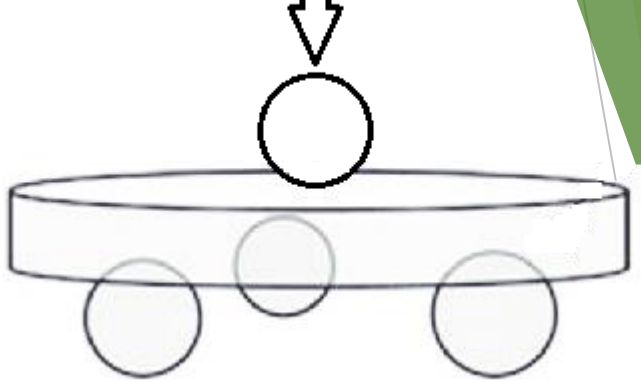




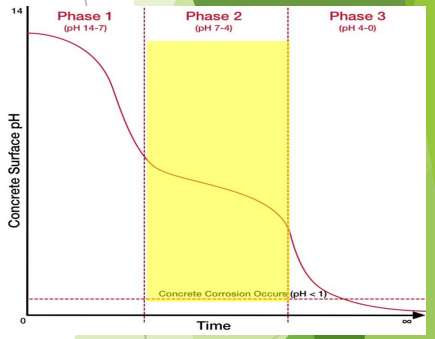


ASTM C1904

3 Test Methods



Test Method A Antimicrobial admixture

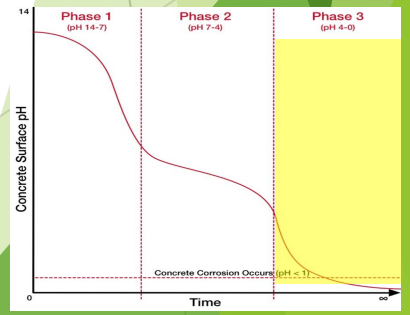


Test Method B Cementitious paste or mortar

B1 - Prescribed cementitious paste and antimicrobial product

B2 - Cementitious paste or mortar with or without antimicrobial products

Test Method C Cementitious paste or mortar



Summary

- MICC occurs through 3 stages
- Mitigation can be done through material, environment and material/environment interface
- Reduce turbulence
- Produce low w/c, high strength, dense good quality concrete
- Permeability reducing – hydraulic and antimicrobial admixtures
- Coatings, sealers and liners
- Consider testing different products/mix designs

C1904 and C1898