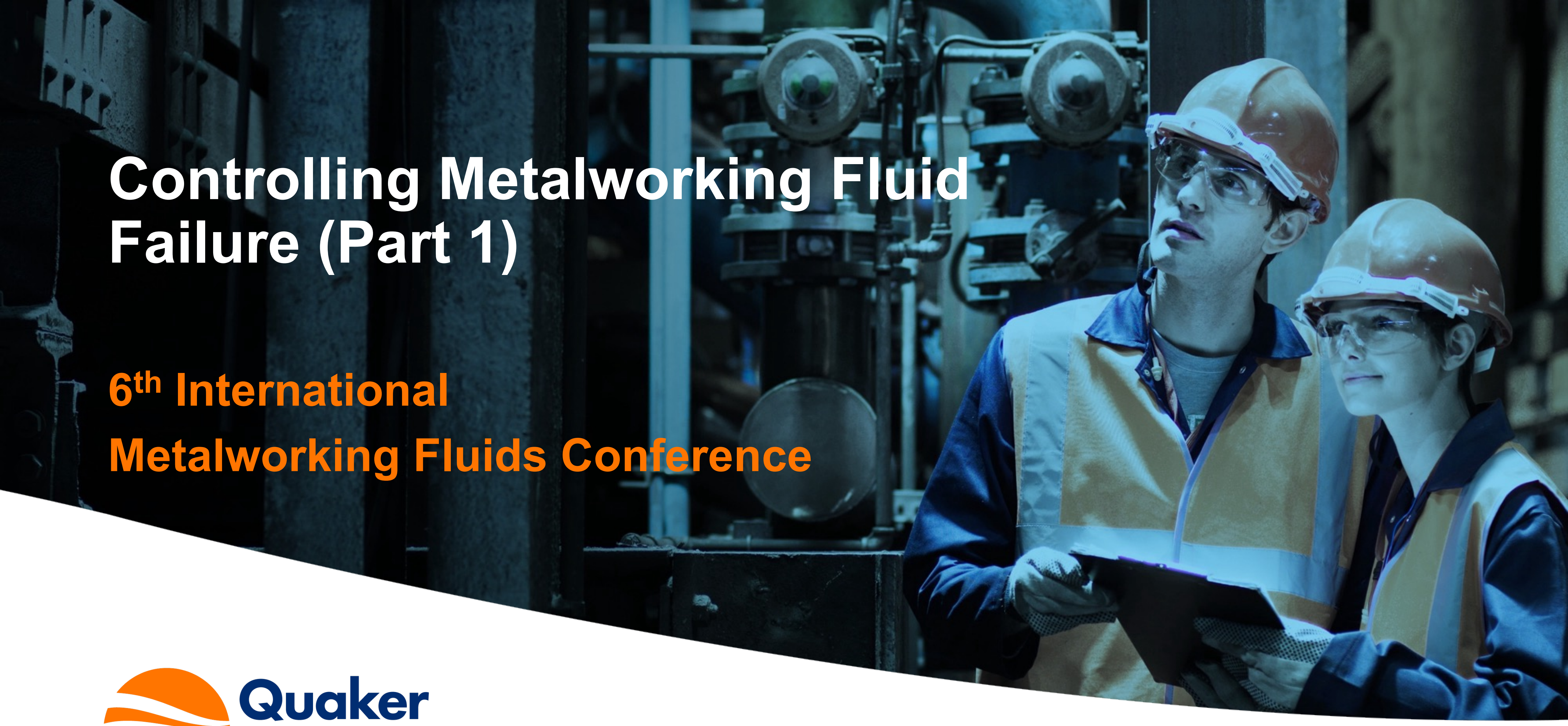
Controlling Metalworking Fluid Failure (Part 1)

6th International Metalworking Fluids Conference



Quaker Houghton™
Forward Together™

John Burke CMFS, FSTLE

Overview

1. Understanding Metalworking Fluid Failure
    a. Water dilutable
    b. Straight oils

2. Corrective Actions

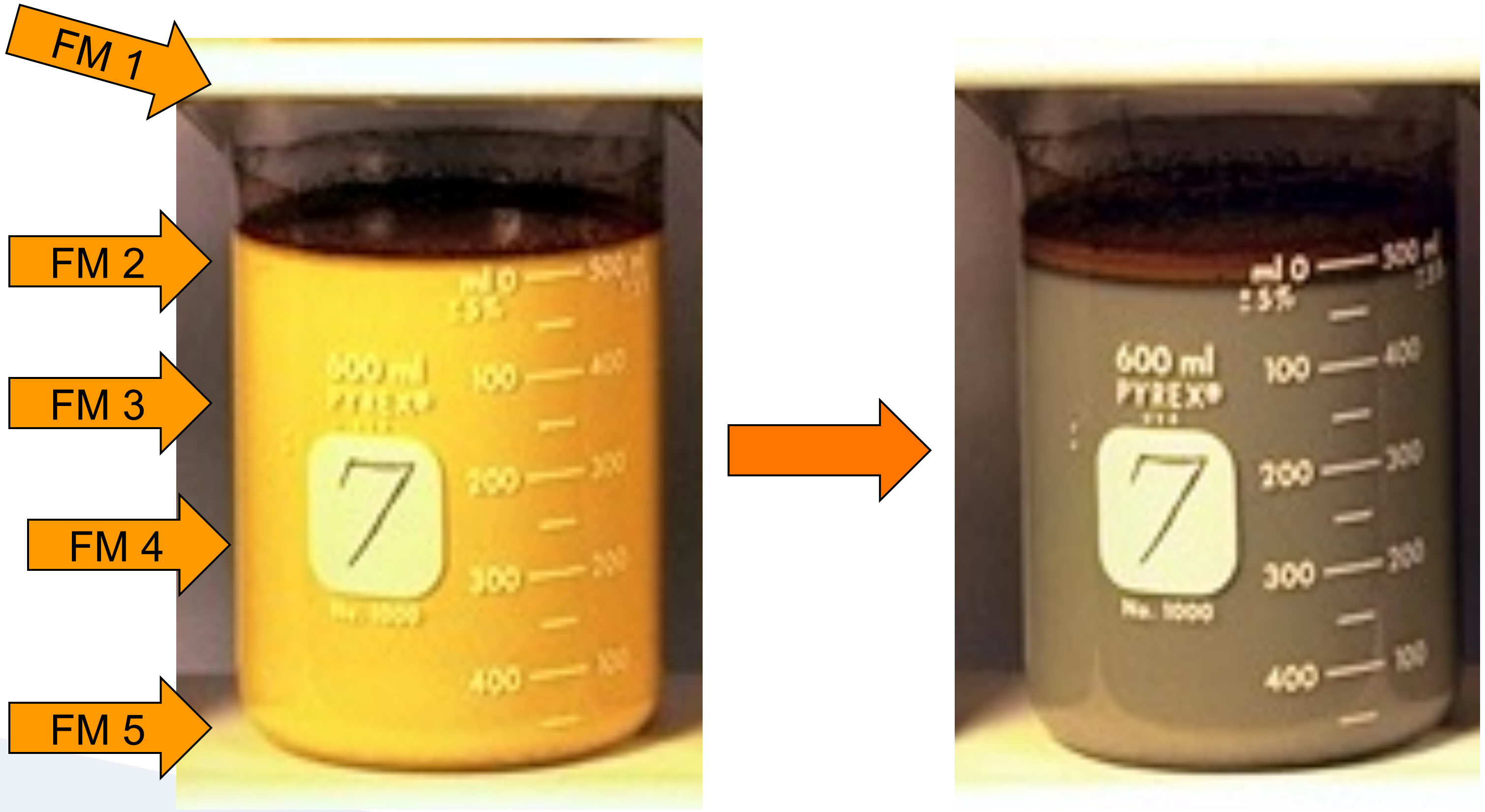
3. Summary

What Causes a Fluid to Fail?

Why Does This **Turn Into This Over Time ?**

What Causes a Fluid to Fail?

**Many
Different
Failure
Mechanisms
Acting
On
The
Fluid**



Five Basic Failure Mechanisms

W

1. Attack by positively charged contaminants
2. Effects of negatively charged contaminants
3. Effects of extraneous oils (tramp oils)
4. Loss of pH
5. Effects from microorganisms (bacteria and fungus)

Less Common Failure Mechanisms

1. High shear forces - cavitation
2. High temperatures greater than180^{o}F
3. Oxidative reactions
4. Galvanic reactions
5. Evaporation of alkaline components – amine loss
6. Evaporation of light oil fractions
7. Leaching of cobalt, zinc, lead and copper
8. Hydrolytic stability of bio-based esters
9. Selective additive stripping - defoamers, oil-like components
10. Poor cold-water mixing
11. Freeze / thaw stability
12. Poor initial mixing
13. Poor grounding / Stray direct currents / Storage tank

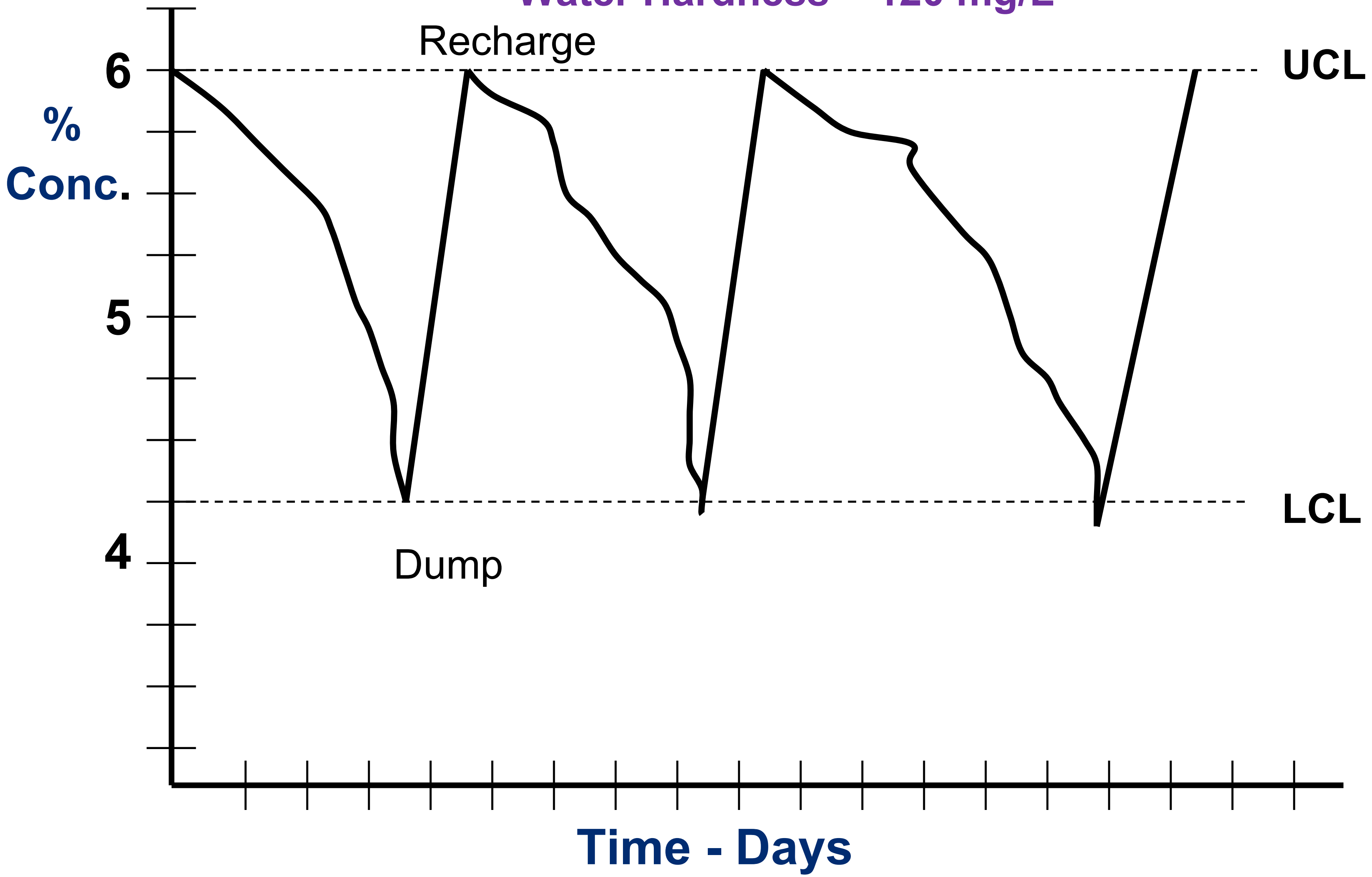
Understanding MWF (Coolant) Failure

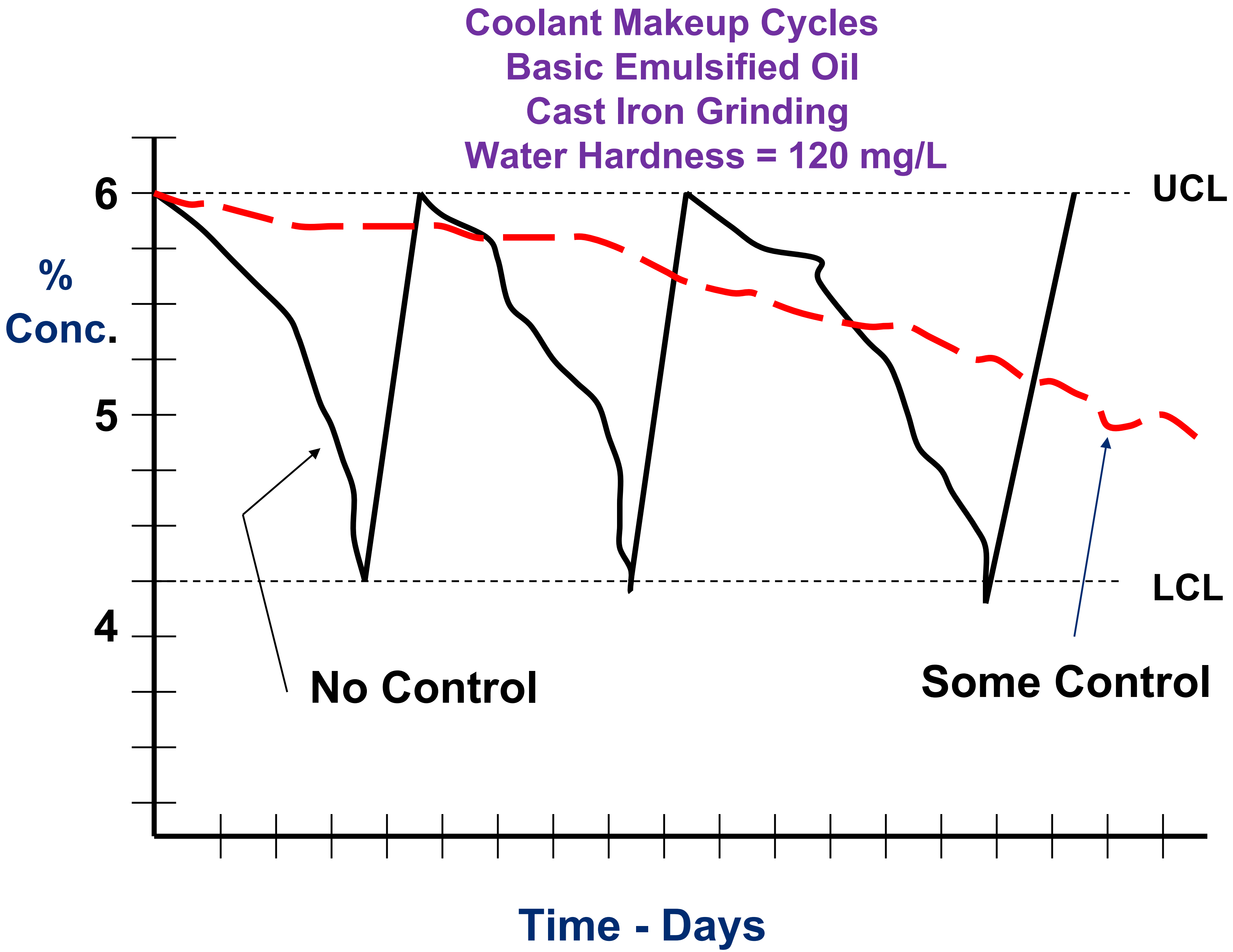
If You Control the Mechanisms That Cause a Metalworking Fluid to Fail, You Will:

1. Have a Cleaner and Safer Working Environment
2. Have Less Waste to Dispose
3. Extend the Life of the Metalworking Fluid
4. Improve Tool Life and the Consistency of Your Metal Removal Processes
5. Reduce Your Overall Operating Cost

Key Words: Failure Mechanisms

Coolant Makeup Cycles
Basic Emulsified Oil
Cast Iron Grinding
Water Hardness = 120 mg/L





Coolant Makeup Cycles
Basic Emulsified Oil
Cast Iron Grinding
Water Hardness = 120 mg/L
6
5
4
%
Conc.
UCL
LCL
No Control
Some Control
Time - Days

Manufacturing Process Variables

Raw Part

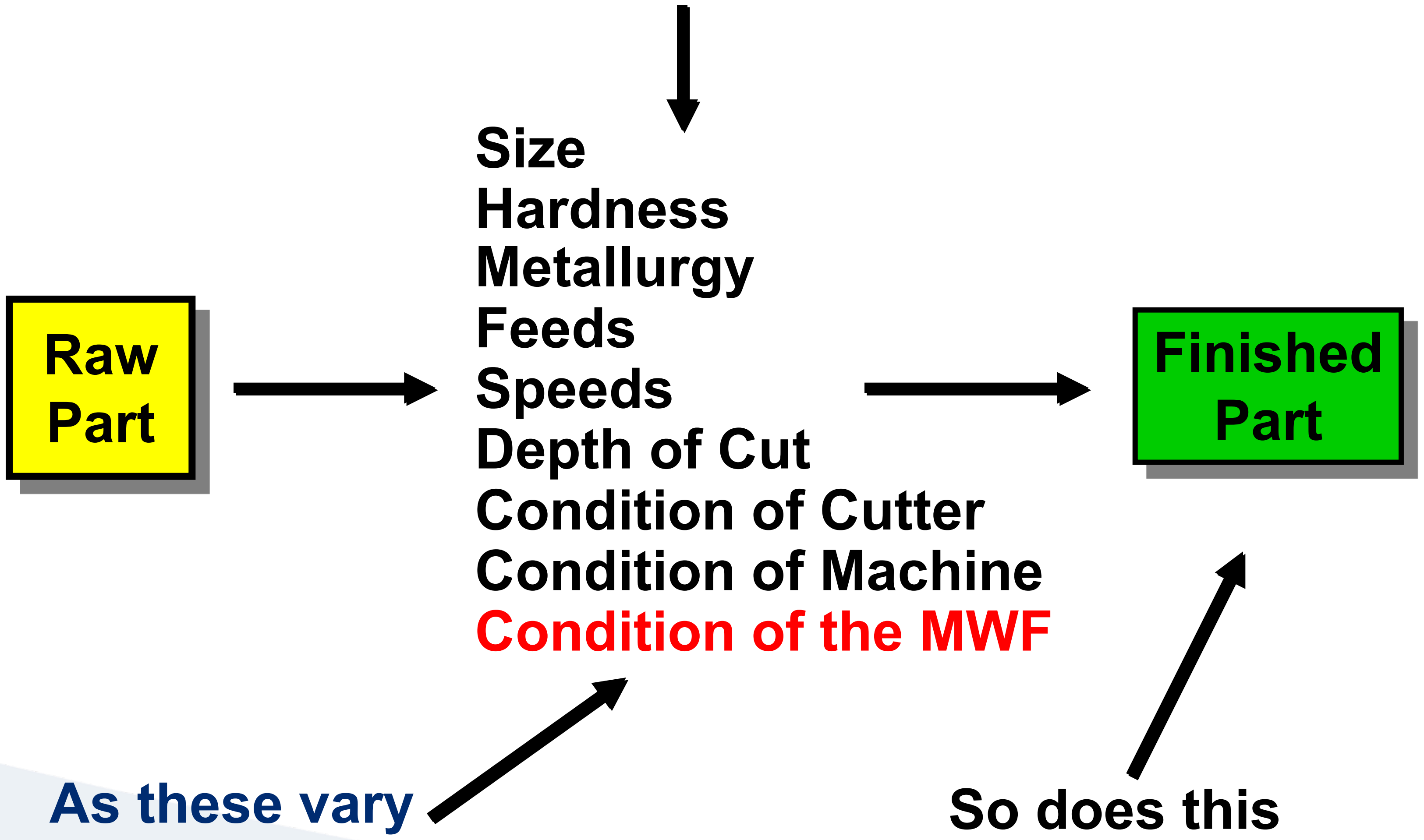
Size
Hardness
Metallurgy
Feeds
Speeds
Depth of Cut
Condition of Cutter
Condition of Machine

Finished Part

As these vary

So does this

Manufacturing Process Variables



Can Failure Rates Be Modified?

1 Week

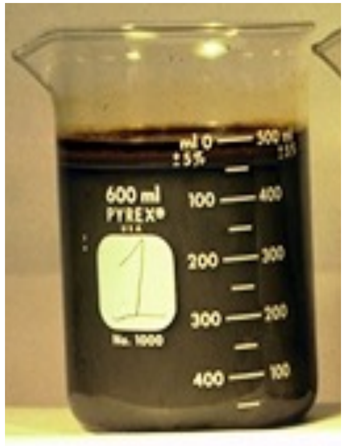
Can Failure Rates Be Modified?

5 Weeks

Can Failure Rates Be Modified?

15 weeks

After 15-Weeks



No Control

Some Control

Biocide +
Filter

Best Control

Biocide +
Filter + pH +
RO water

Conclusion

Failure rates can be modified

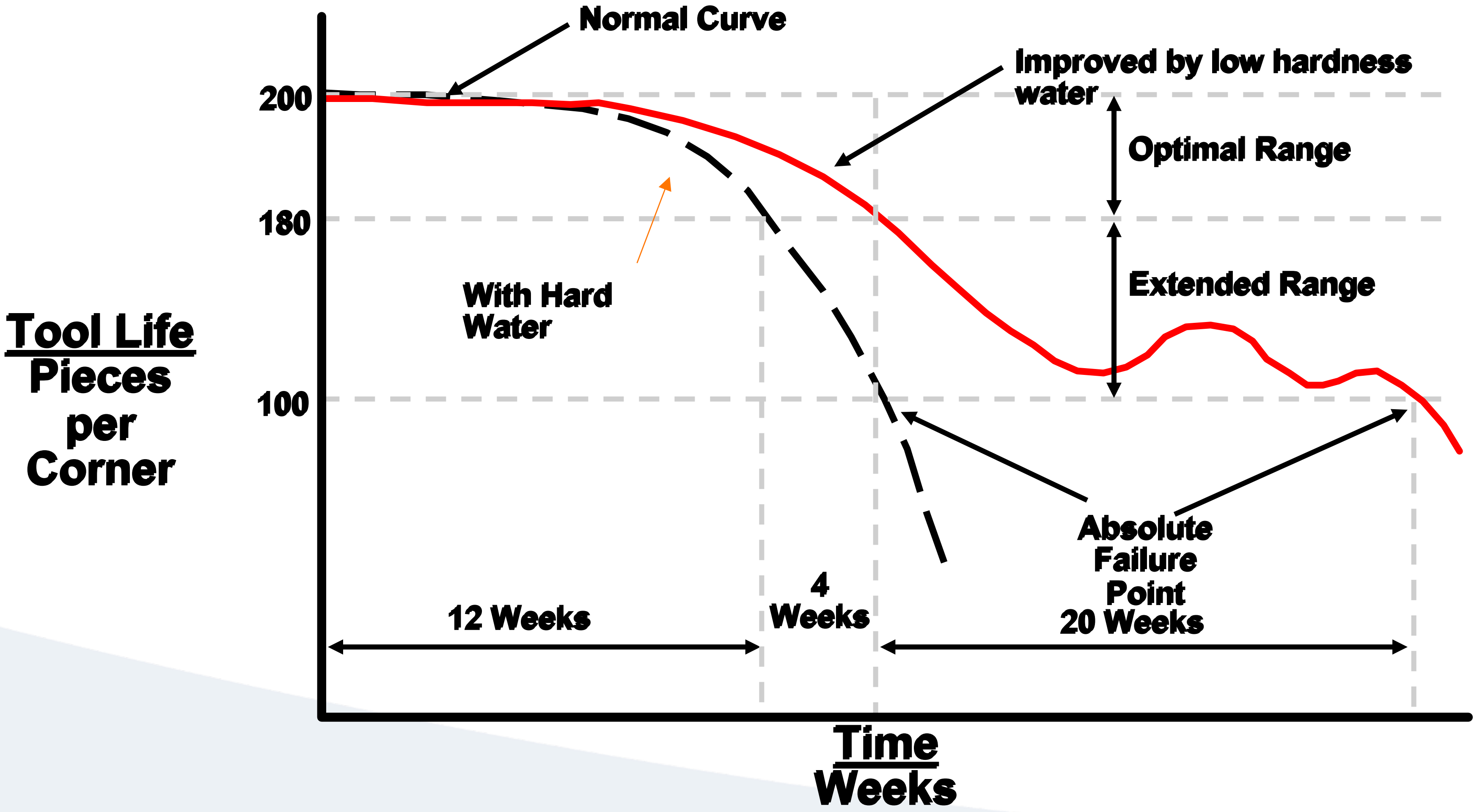
Recycled MWF

This fluid "looks good" but can you machine at optimum feed and speeds with it?

Is it still safe to the worker?

Or should this fluid be discarded?

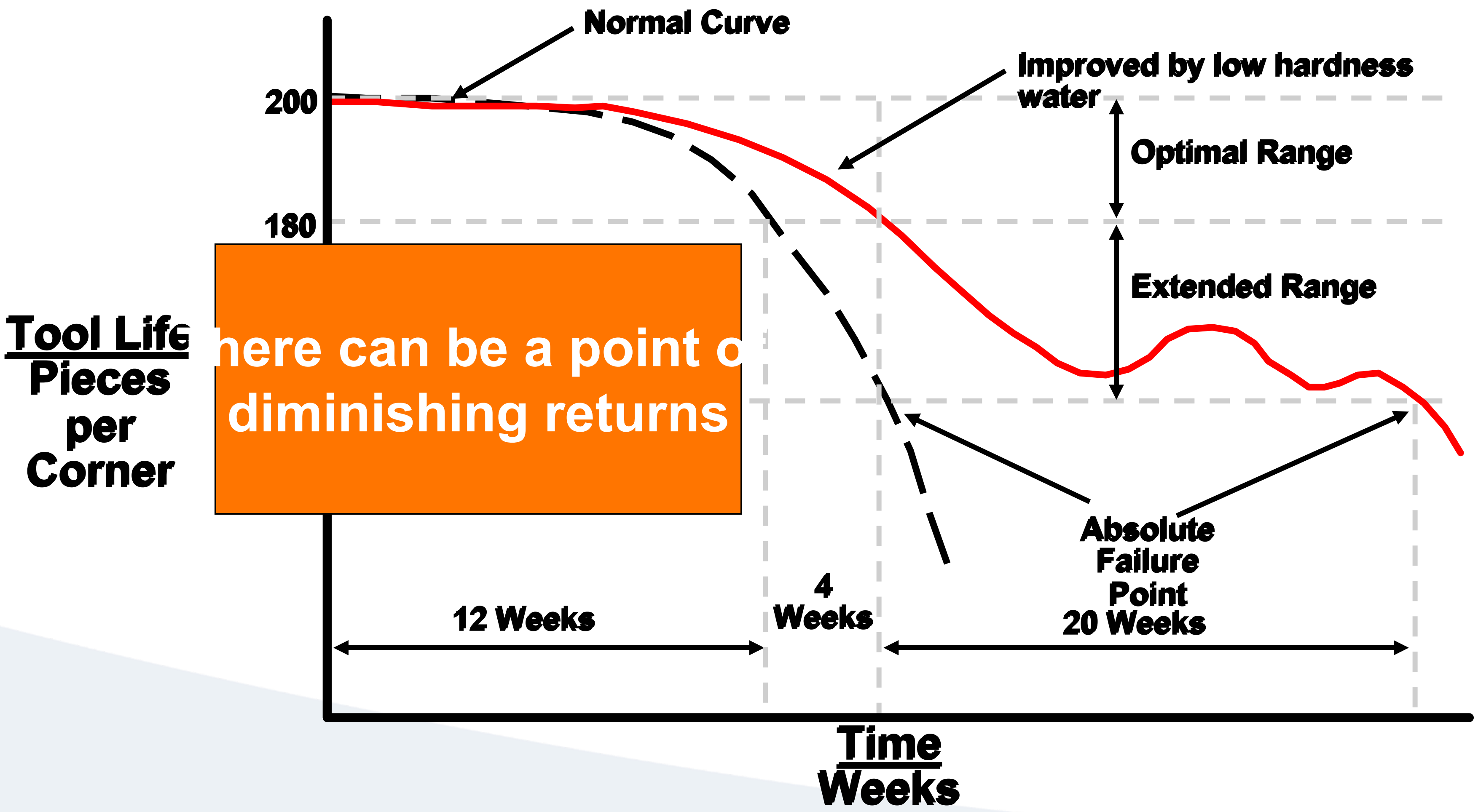
Tool Life versus Time



Quaker Houghton Forward Together

Turning SAE 8620 Steel
Coated Carbide Insert

Tool Life versus Time



here can be a point o
diminishing returns

Turning SAE 8620 Steel
Coated Carbide Insert

Why Fluids Fail

Three Basic Water Reducible MWF Formulations

Emulsifiable Oil (Soluble Oil)	Oil + Anionic Soap + Rust Preventative + Coupling Agent + Biocide + Buffer
Semi-Synthetic	Oil + Synthetic Component + Anionic Soap + Coupling Agent + Rust Preventative + Buffer + Biocide
Synthetic	Synthetic Component + Fatty Acid + Anionic Wetting Agent + Rust Preventative + Buffer + Biocide

Why Fluids Fail

Highlighted areas
Are negatively charged

Three Basic Water Reducible MWF Formulations

Emulsifiable Oil (Soluble Oil)	*Oil* + **Anionic Soap** + **Rust Preventative** + *Coupling Agent* + *Biocide* + *Buffer*
Semi-Synthetic	*Oil* + *Synthetic Component* + **Anionic Soap** + *Coupling Agent* + **Rust Preventative** + *Buffer* + *Biocide*
Synthetic	*Synthetic Component* + **Fatty Acid** + **Anionic Wetting Agent** + **Rust Preventative** + *Buffer* + *Biocide*

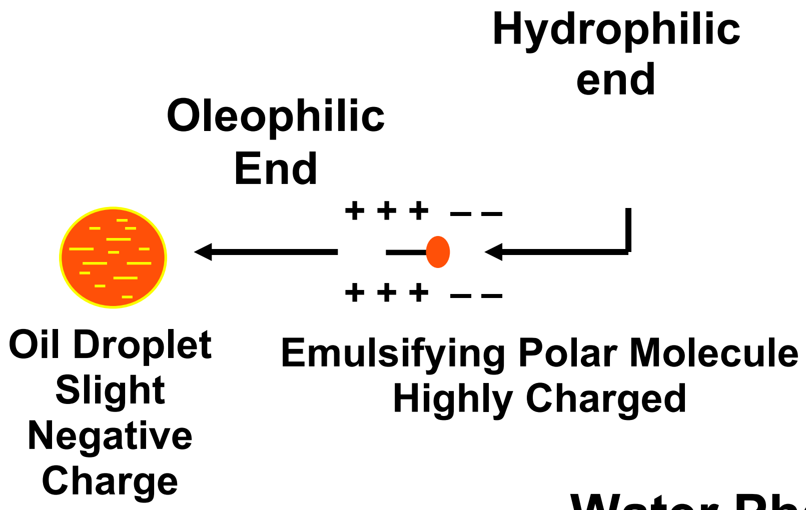
Failure Mechanism #1
Cation Attack

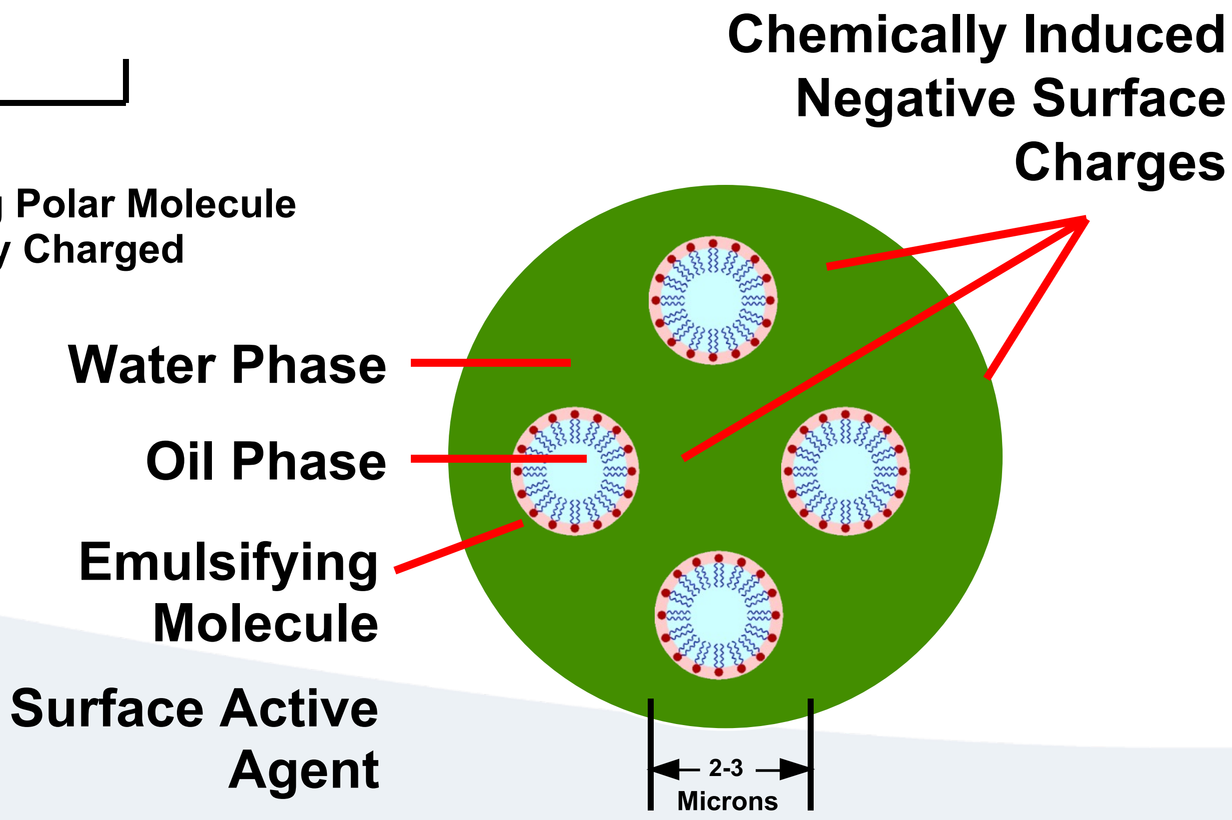
Type of metal being machined

Most Destructive:	**Cast or Ductile Iron**	Fe^{+++}
	Certain Grades of Aluminum	Al^{+++}
	Magnesium	Mg^{++}
Mildly Destructive:	**AISI/SAE 1020, 4140, 8620**	
	Brass	
	Lead	
	Copper	
Least Destructive:	**Stainless Steel**	
	Ultra-Alloys Such as Incoloy	
Key Words:	**Type of metal being cut**	

Failure Mechanism #1
Cation Attack

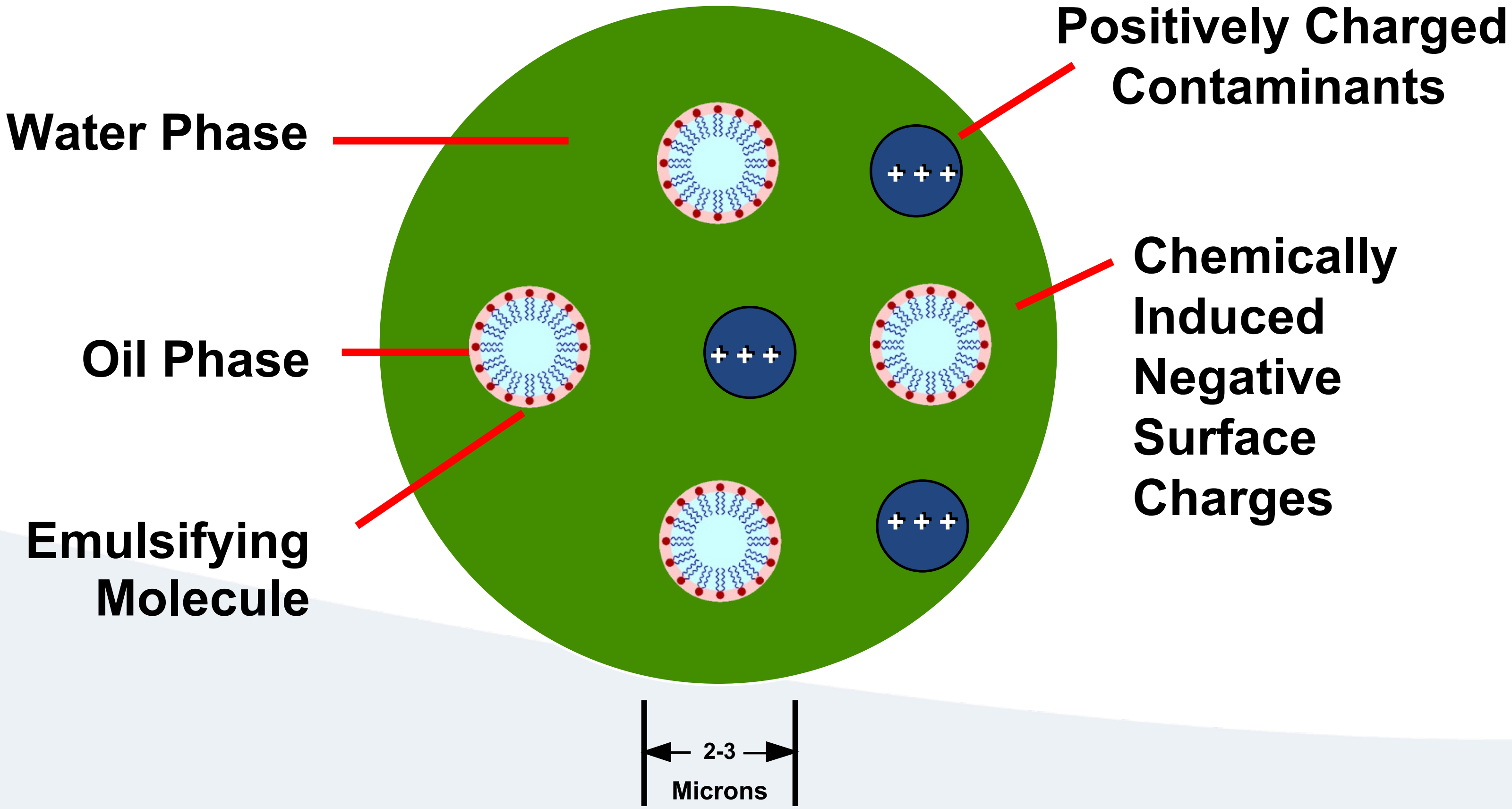
Typical Emulsified Oil MWF Schematic





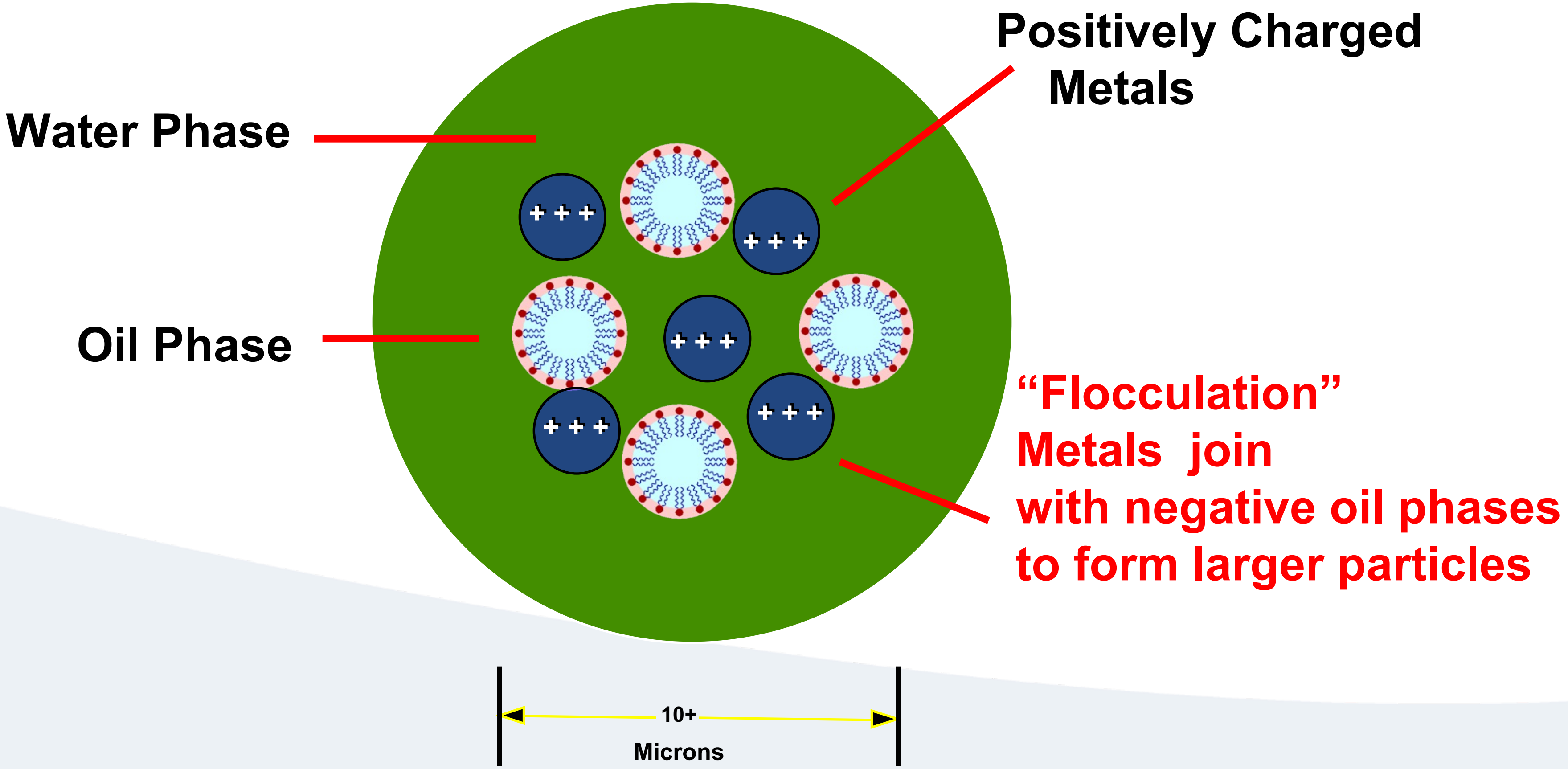
Failure Mechanism #1
Cation Attack

Typical Emulsified Oil MWF Schematic
On the Road to Failure



Basic Fluid Failure by Cation Attack

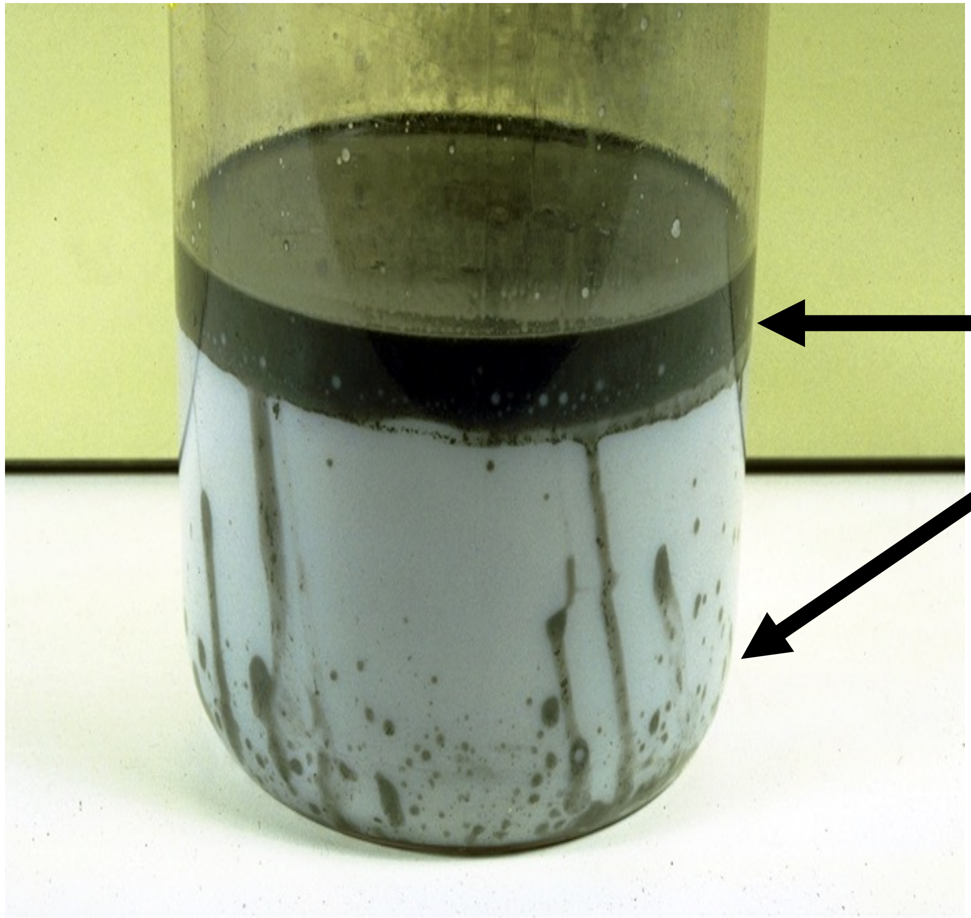
Typical Emulsified Oil MWF Schematic



Cast Iron Grinding Experiment

Cast Iron
Grinding Experiment

Failure Mechanism #1
Cation Attack

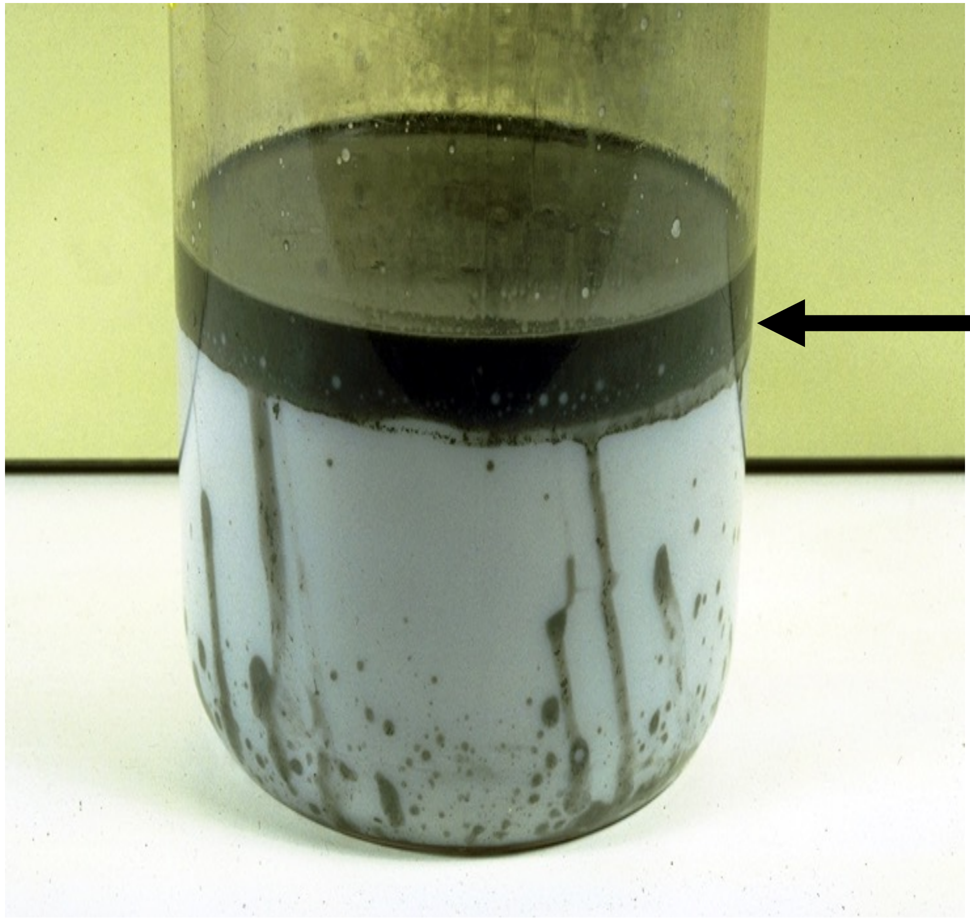


Coolant split after 15 minutes of intense grinding

Initial Concentration 20% v/v

Cast Iron Grinding Experiment

Failure Mechanism #1
Cation Attack



Iron Soaps
Not Tramp Oil

Cast Iron
Grinding Experiment

Failure Mechanism #1
Cation Attack

Size and rate of metal being machined (in relation to volume of coolant)

Most Destructive:	**Grinding, polishing, ball grinding**
Mildly Destructive:	**Sawing, CBN grinding, milling**
Least Destructive:	**Single point turning**
Key Words:	**Size and rate of chips cut; Volume of fluid surface area of metal removed / volume of fluid**

Failure Mechanism #1
Cation Attack

Machining generates a lot of surface area

Grind 1 square foot of steel into 50-micron cubes

6 square feet **becomes** **35,720 square feet**

1’ x 1’ x 6 sides **50-micron cubes**

Filtration Example - Cation Attack

15,000 Gallon System

- Copper alloy
- Wire Drawing - copper

  - 1,000 Total suspended solids
  - 210 mg/L < 8 micron
  - 168 mg/L < 0.45 micron
  - 120 mg/L < 0.2 micron

- Over time metal particles built up linearly while surface area of dirt built up exponentially.
- Once coolant hit these dirt levels, failure occurred in 5 days.

Failure Mechanism #1
Cation Attack

Type of water entering the system

Most Destructive:	**Hard water above 10 grain hardness (170 PPM)** **Low pH water (below 7.0)**
Target:	**Water purity less than 1 grain hardness** **pH of 7.0 or higher** **Less than 15 PPM total dissolved solids**
Key Words:	**Hard water, total dissolved solids, pH**

What are Areas of Concern When Using This Water ?

CANTON WATER DEPARTMENT, WATER ANALYSIS - 2003

INORGANIC CONTAMINANTS	DATE SAMPLED	SAMPLING FREQUENCY	NORTHEAST WATER PLANT	NORTHWEST WATER PLANT	SUGARCREEK WATER PLANT	MCL*
ALKALINITY, mg/l AS CaCO3	Avg. 02	MONTHLY	238	288	201	NA
ALKALINITY STABILITY, mg/l AS CaCO3	Avg. 02	MONTHLY	236	276	188	NA
ASBESTOS, fibers >10um length/l	9-1-95	NA	<200,000	<200,000	<200,000	7Million
CALCIUM TOTAL, mg/l as CaCO3	2-25-98	NA	358	369	270	NA
CHLORIDE, mg/l	Avg. 96	MONTHLY	90	90	32	250
CHLORINE, FREE, mg/l, Daily Min.	Avg. 02	DAILY	0.9	0.9	0.9	0.2 Minimum
CYANIDE TOTAL, as (CN) mg/l	9-18-95	NA	<0.005	<0.005	<0.005	0.2
FLUORIDE, mg/l	Avg. 02	DAILY	1.1	1.0	1.1	4.0
TOTAL HARDNESS, mg/l as CaCO3	Avg. 02	MONTHLY	408	475	369	NA
TOTAL HARDNESS, grains per gal.	Avg. 02	MONTHLY	24	28	22	NA
MAGNESIUM TOTAL, mg/l as CaCO3	2-25-98	NA	115	119	91	NA
NITRATE, mg/l NO3 as N	9-16-02	NA	<0.1	<0.1	<0.1	10.0
NITRITE, mg/l NO2 as N	7-28-98	NA	<0.1	<0.1	<0.1	1
pH	Avg. 02	WEEKLY	7.1	7.1	7.6	WITHIN 6.5-8.5
TURBIDITY, NTU	Avg. 02	WEEKLY	0.06	0.18	0.14	1.00
ANTIMONY ug/l	9-12-01	EVERY 3 YRS	<3.0	<3.0	<3.0	6
ARSENIC ug/l	9-12-01	EVERY 3 YRS	<3.0	<3.0	<3.0	50
BARIUM ug/l	12-9-96	NA	<300	<300	<300	2000
BERYLLIUM ug/l	9-12-01	EVERY 3 YRS	<.5	<.5	<.5	4
CADMIUM ug/l	12-9-96	NA	<1.0	<1.0	<1.0	5
CHROMIUM ug/l	12-9-96	NA	<10.0	<10.0	<10.0	100
COPPER ug/l	12-9-96	NA	<50	<50	<50	1300
IRON mg/l	Avg. 02	WEEKLY	0.032	0.070	0.035	0.300
LEAD ug/l	12-9-96	NA	<1	<1	<1	15
MANGANESE mg/l	Avg. 02	WEEKLY	0.030	0.031	0.030	0.05
MERCURY ug/l	12-9-96	NA	<0.5	<0.5	<0.5	2
NICKEL ug/l	9-12-01	EVERY 3 YRS	<10.0	<10.0	<10.0	100
SELENIUM ug/l	12-9-96	NA	<5	<5	<5	50
SILVER ug/l	9-18-95	NA	<0.8	<0.8	<0.8	100
SODIUM mg/l	Avg. 99	NA	44	55	15	NA
THALLIUM ug/l	9-12-01	EVERY 3 YRS	<1.0	<1.0	<1.0	2
TOTAL TRIHALOMETHANES ug/l	Avg. 02	Qrtly	16.7	13.2	22.6	80
ZINC mg/l	12-9-98	NA	<0.02	<0.02	<0.02	5

Water Report

Inorganic Contaminant	Date Sampled	Sampling Frequency	North Well Field	West Well Field	South Well Field
Calcium	January 2006	Monthly	358	369	270
Hardness	January 2006	Quarterly	408	475	369
Magnesium	January 2006	Quarterly	115	119	91
Sodium	January 2006	Monthly	44	55	15
Chloride	January 2006	Monthly	90	90	32

Water Report

Three Water Sources

Inorganic Contaminant	Date Sampled	Sampling Frequency	North Well Field	West Well Field	South Well Field
Calcium	January 2006	Monthly	358	369	270
Hardness	January 2006	Quarterly	408	475	369
Magnesium	January 2006	Quarterly	115	119	91
Sodium	January 2006	Monthly	44	55	15
Chloride	January 2006	Monthly	90	90	32

Water Report

Significant Variation Between Water Sources

Inorganic Contaminant	Date Sampled	Sampling Frequency	North Well Field	West Well Field	South Well Field
Calcium	January 2006	Monthly	358	369	270
Hardness	January 2006	Quarterly	408	475	369
Magnesium	January 2006	Quarterly	115	119	91
Sodium	January 2006	Monthly	44	55	15
Chloride	January 2006	Monthly	90	90	32

Significant Cation Load

Water Report

Inorganic Contaminant	Date Sampled	Sampling Frequency	North Well Field	West Well Field	South Well Field
Calcium	January 2006	Monthly	358	369	270
Hardness	January 2006	Quarterly	408	475	369
Magnesium	January 2006	Quarterly	115	119	91
Sodium	January 2006	Monthly	44	55	15
Chloride	January 2006	Monthly	90	90	32

Nasty Anion

Water Report

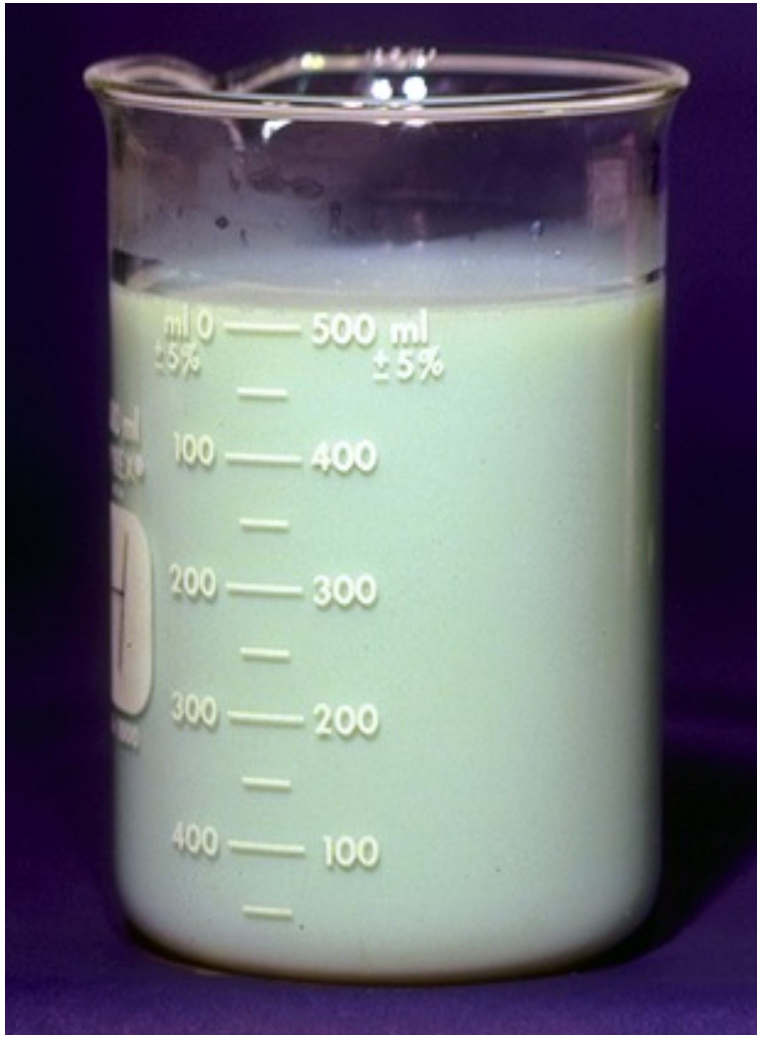
Inorganic Contaminant	Date Sampled	Sampling Frequency	North Well Field	West Well Field	South Well Field
Calcium	January 2006	Monthly	358	369	270
Hardness	January 2006	Quarterly	408	475	369
Magnesium	January 2006	Quarterly	115	119	91
Sodium	January 2006	Monthly	44	55	15
Chloride	January 2006	Monthly	90	90	32

Failure Mechanism #1
Cation Attack

Amount of water entering the system per day

Most Destructive:	**10% or greater of system volume/day**
Least Destructive:	**5-7% of system volume/day**
Mildly Destructive:	**1-2% of system volume/day** **Loss must be by evaporation, not by carry out**
Key Words:	**Evaporation rate**

Failure Mechanism #1
Cation Attack



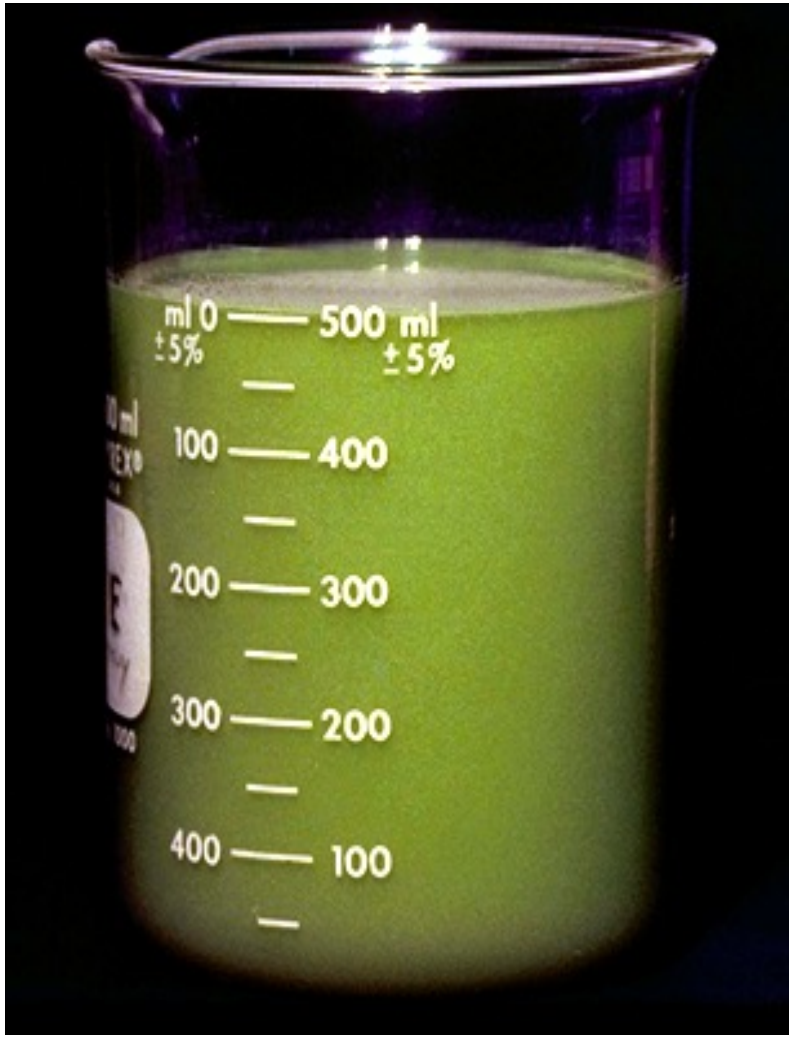
Premium emulsified oil

5 % V/V

120 PPM

Initial concentration

Failure Mechanism #1
Cation Attack



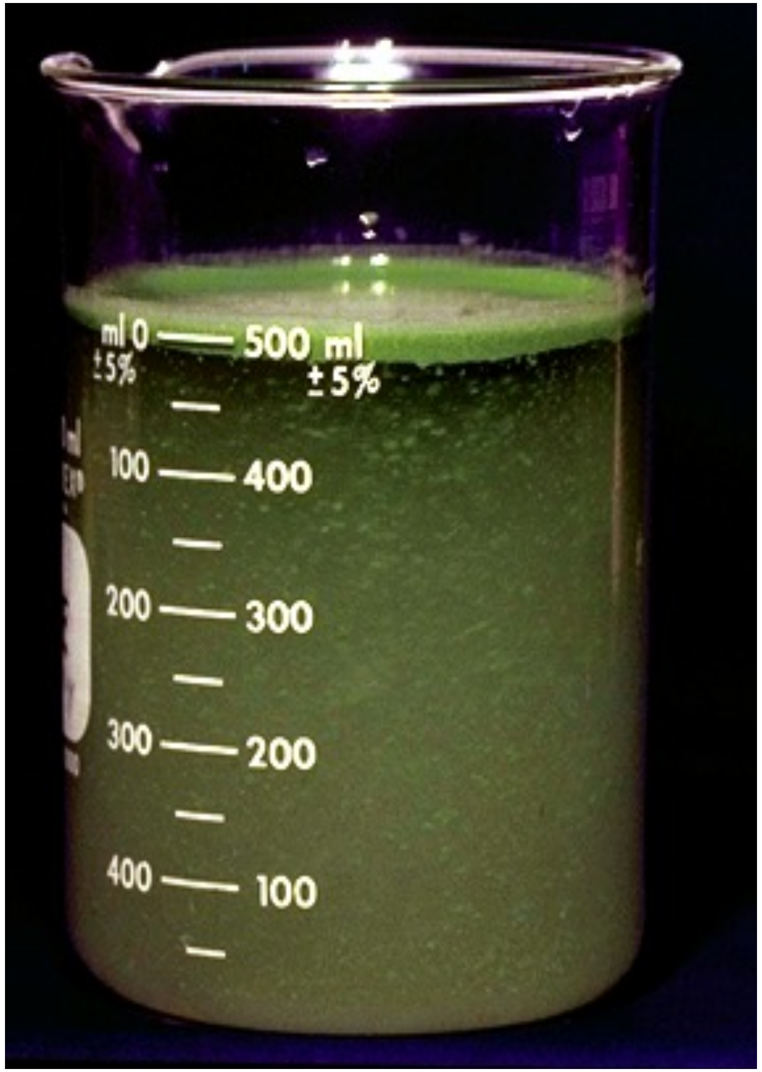
Premium emulsified oil

5 % V/V

600 PPM

5 concentration cycles

Failure Mechanism #1
Cation Attack



Premium emulsified oil

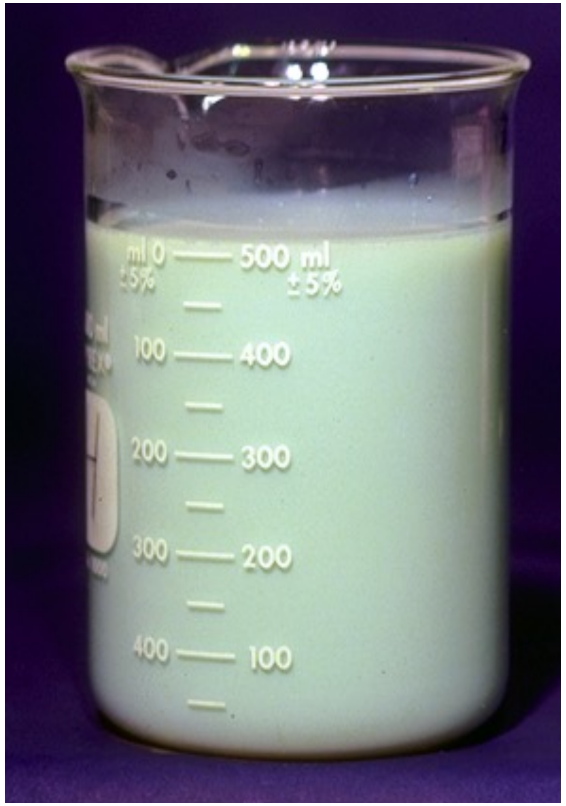
5 % V/V

1200 PPM

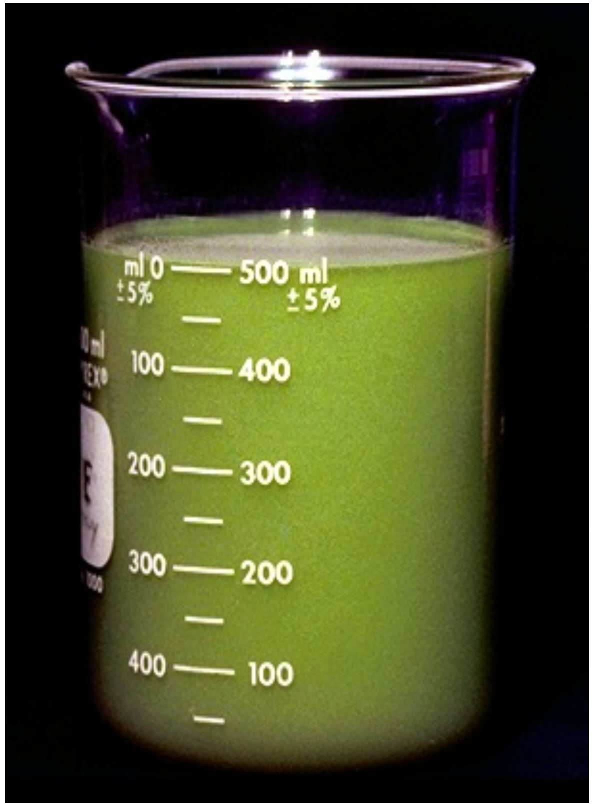
10 concentration cycles

Failure Mechanism #1
Cation Attack

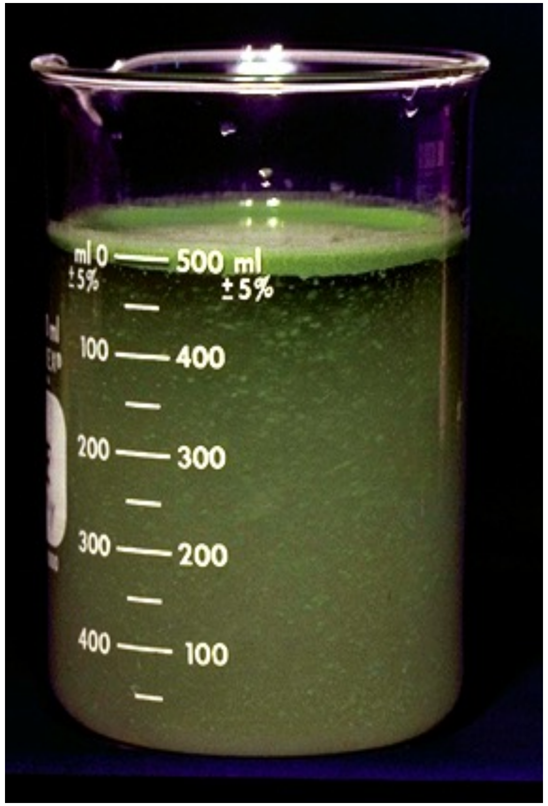
Premium Emulsified Oil
Effects of Evaporation and Water @ 120 PPM Hardness



Initial

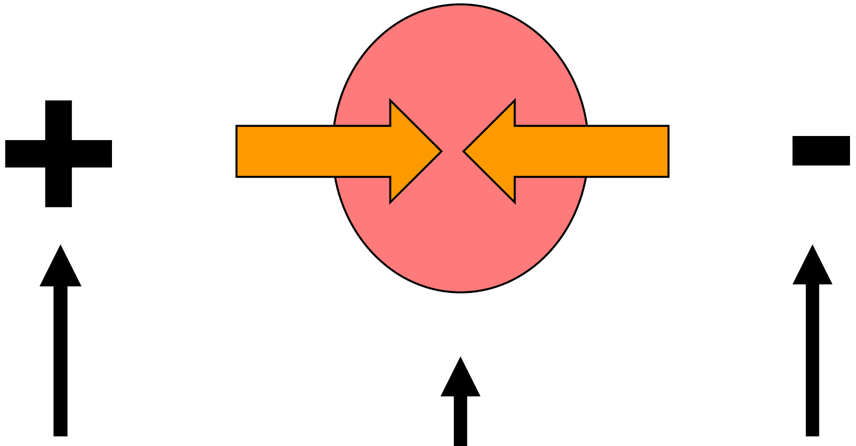


5 X



10 X

For This Reaction, It’s Mostly About Plusses and Minuses



One group of
failure mechanisms are
Positively Charged
CATIONS

Key Components of
a MWF are
Negatively Charged

When the two groups come together
MWF failure begins

Advantages and Disadvantages of Using Pure Water

- Easier mixing
- Smaller particle size
- Improved wetting and penetration
- Minimizes gummy residues
- Improved filtration
- Less carry-off
- Greater bacterial resistance
- Greater fungus resistance
- Reduced corrosion
- Less concentrate use
- Less mist
- Better overall stability

Disadvantages of Using Pure Water

- May lessen tool life on some operations
- Increases risk of generating foam

Quaker Houghton™
Forward Together™

Pure Water Myth #1

Soft water is OK for use in coolants

True or False

Pure Water Myth #1

Soft water is OK for use in C\coolants

False

Hard Water	$H_2O + CaCO_3$
True “Soft” Water	$H_2O + Na_2CO_3 + Cl^-$

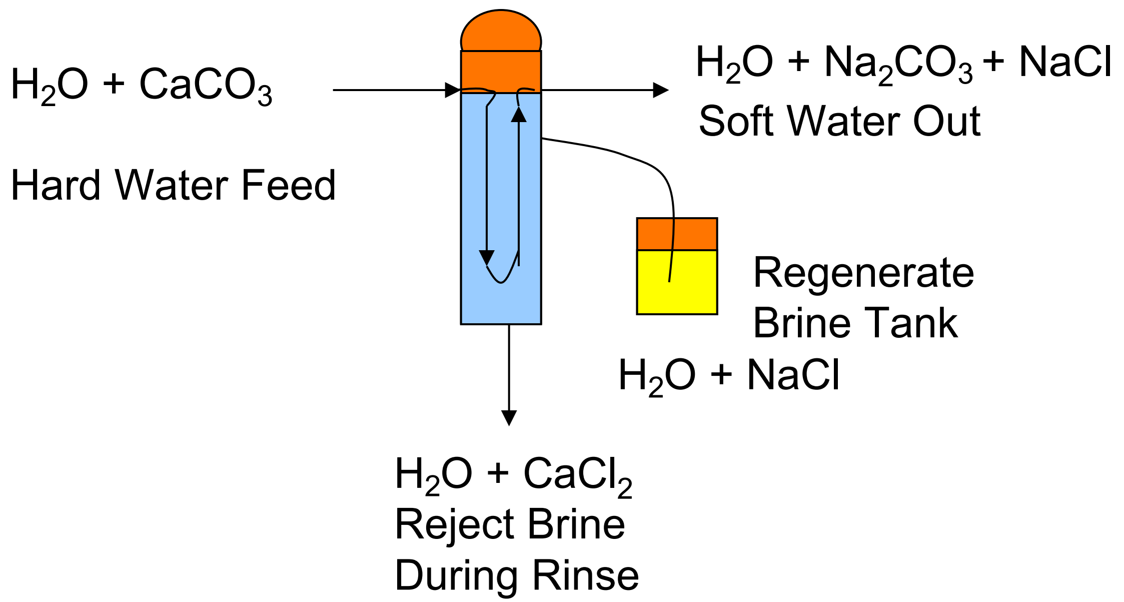
Note: Two Sodium Ions for Every Calcium ion – TDS actually goes up

Total Dissolved Solids = Sum of Cations plus Anions + Soluble organics

Hey, where did the chloride ion come from???

Pure Water Myth #1

Traditional Water Softener



Before and After Water Softening

Tap Water with
0.25 mg/L Fe
220 mg/L as Ca
One liter evaporated

Tap Water after Softening
0.02 mg/L Fe
3 mg/L as Ca
One liter evaporated

Pure Water Myth #2

Rain Water or Air Conditioning Condensate is OK for Coolants

True or False

Pure Water Myth #2

Rain Water or Air Conditioning Condensate is OK for Coolants

False:

While the rain water may be soft, when it hits the roof it is full of dirt and bacteria, fungus, algae.

Same for air conditioning coils.

Water Basics

Hard Water

Expressed as:

Cation **Positive** **Charge** → Ca^{++}

Anion **Negative** **Charge** → CO_3^{--}

$$H_2O + Ca^{++}CO_3^{--}$$

Hardness, milligram equivalent $CaCO_3$/L =
= 2.496 * (Ca, mg/L) + 4.118 * (Mg, mg/L)

Remember: For every Cation there is a corresponding Anion

Failure Mechanisms

Battle of the Cations

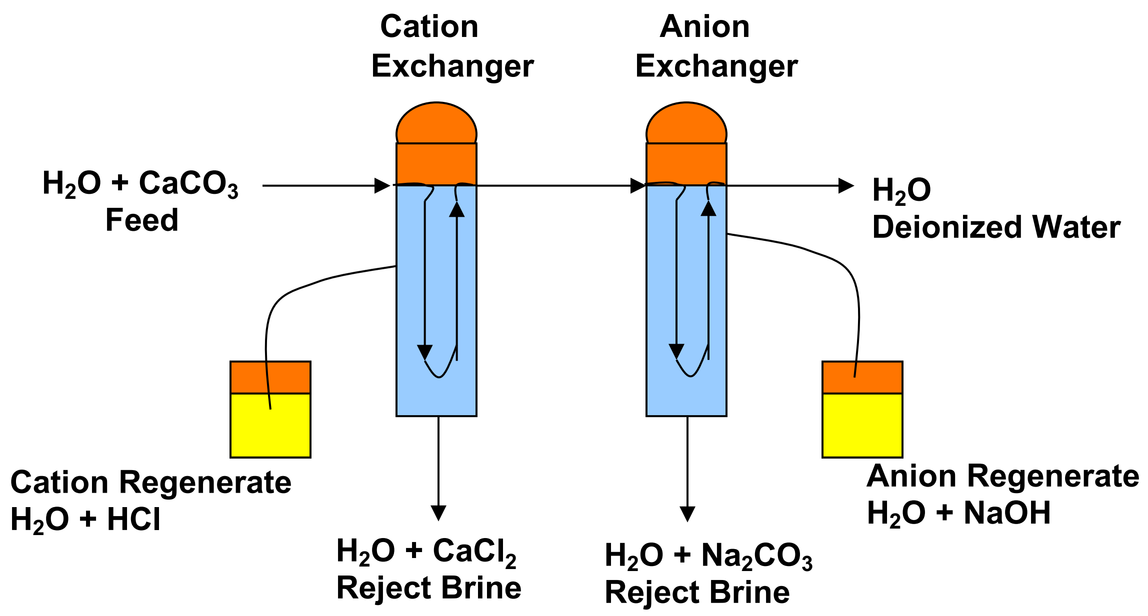
Cation	Symbol & Charge	Hard Water	Metal Machined	Waste Water Treatment
Zinc	Zn^{++}		x	
Calcium	Ca^{++}	x		x
Magnesium	Mg^{++}	x	x	x
Iron Ferrous	Fe^{++}		x	x
Iron Ferric	Fe^{+++}		x	x
Aluminum	Al^{+++}		x	x
Titanium	Ti^{++++}		x	

Failure Mechanism #2

Those Nasty Anions

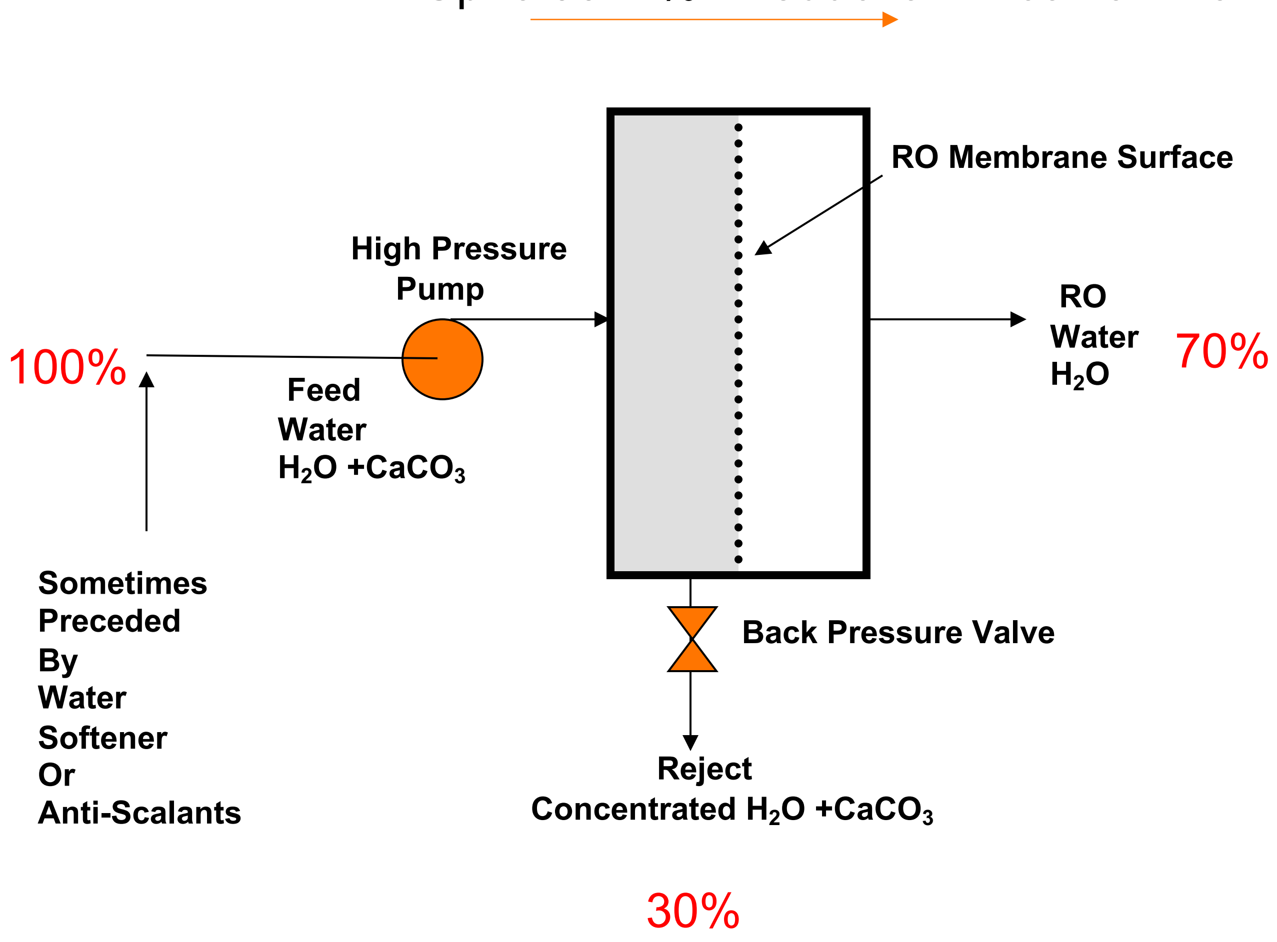
Enemy # 1	Chloride	Cl	=	Corrosion
	Sulfate	SO_4	=	Significant Food Source
	Phosphate	PO_4	=	Significant Food Source
	Nitrate, Nitrite	NO_3, NO_2	=	Nutrient
	Carbonate	CO_3	=	Nutrient

Traditional Dual Bed DI System



Reverse Osmosis (RO) Water System

Up to 99.7 % + reduction in contaminants



All Water Conditioning Systems Can Fail

1. They can actually produce worse water than what you started with.

2. They can confuse you thinking you have treated water when you do not.

3. They can fail intermittently, and / or without warning

4. A word to the wise:
    a. Never totally trust a water purification device
    b. Check it out.

Pure Water Myth #3

Pure Water has a pH of 7.0

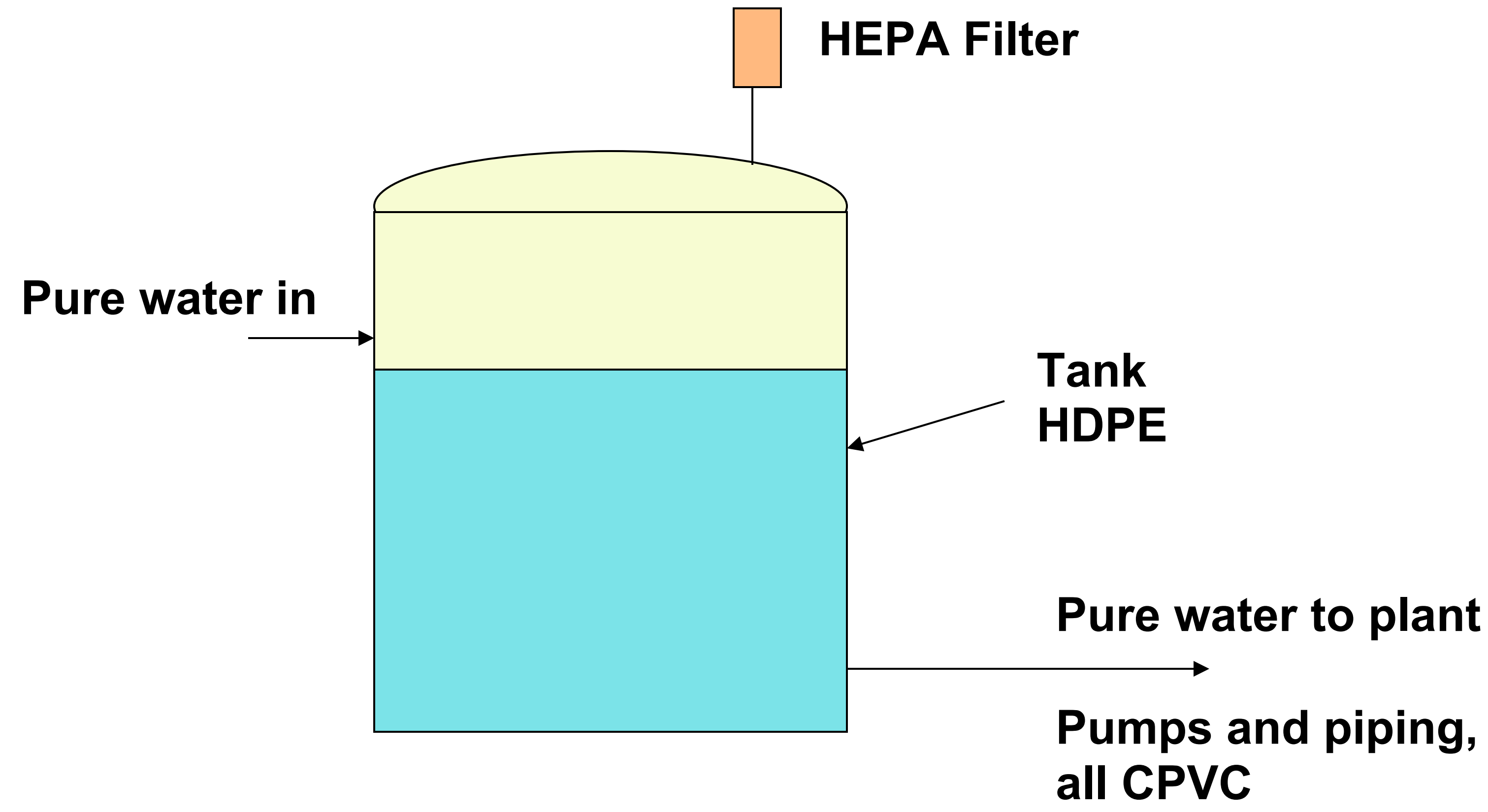
Pure Water Myth #3

Pure Water has a pH of 7.0

True, but only for a while

- **Absorbs carbon dioxide from the air and turns acid, as low as 5.5 pH**

Pure Water Storage Is Critical



Water Myth #4

One water analysis is all I need to
make further decisions about my water concerns

True or False

Water Myth #4

One water analysis is all I need to
make further decisions about my water concerns

False

Most Water Sources Vary Considerably
Seasonally
Sometimes even hourly

Hint: Get as many water analyses as you can
over the course of a year

Know Your Terms

Hard Water	Soft Water
Above 170 mg/L Total hardness	Below 10 mg/L Total Hardness
	Below 1 mg/L = “Dead Soft”
	RO Water DI Water Deionized Water Demineralized Water Pure Water Sodium Softened Water

Controlling Metalworking Fluid Failure (Part 2)

6th International Metalworking Fluids Conference

Quaker Houghton™
Forward Together™

John Burke CMFS, FSTLE

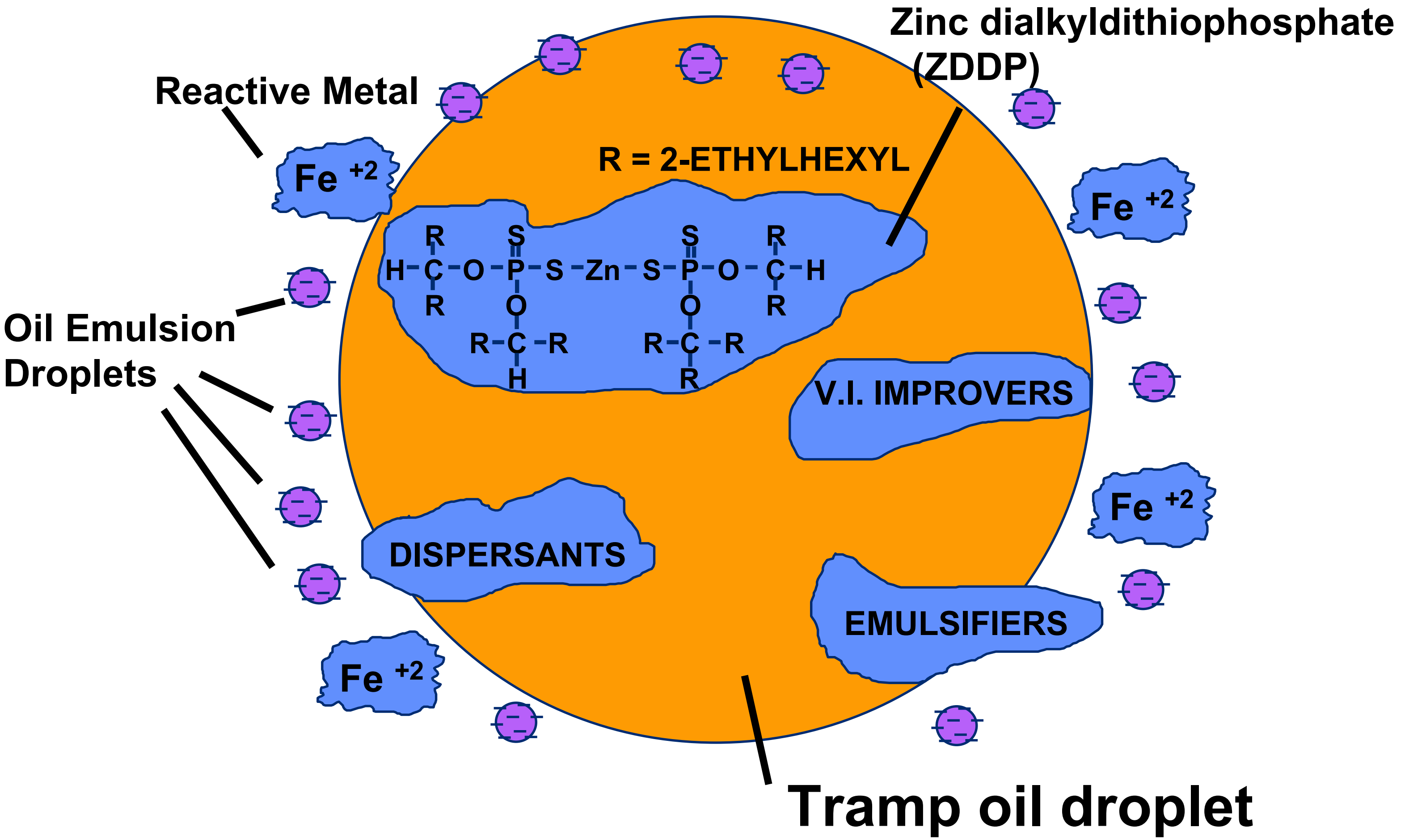
Failure Mechanism #3
Tramp Oil

Type and amount of hydraulic and way oils entering the system

Most Destructive:	**Certain premium hydraulic oils – Those fluids known as both anti-wear and rust and oxidation types and emulsifying way oils**
Mildly Destructive:	**Rust and oxidation oils**
Least Destructive:	**Hydraulic and way oils *not* based on traditional organo-metallic phosphate chemistry (Ashless)**
Key Words:	**Zinc dialkyldithiophosphate, Anti-Wear, Rust and Oxidation, Emulsifying Way Oils**

Failure Mechanism #3
Tramp Oil

Tramp oil is not just "oil"



Tramp Oil Failure Theories

1. Sharing of the emulsifier – The HLB theory
    a. Too much oil, not enough emulsifier
2. Reactivity of the ZDDP molecule
    a. Sulfur and phosphorus availability. Bacterial nutrients
3. Dispersants and de-emulsifiers in hydraulic oil upset the HLB balance

Tramp Oil Myth #1

If I add emulsifiers to the coolant mix, I will eliminate the effects of tramp oil contamination

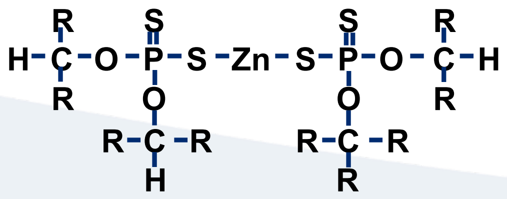
- True or False

Tramp Oil Myth #1

If I add emulsifiers to the coolant mix, I will eliminate the effects of tramp oil contamination

False

- **A. Not the proper way to make an emulsion**
  - **More likely to cause foam than to couple up the tramp oil.**
- **B. Wrong or mismatched viscosities**
- **C. What about the Sulfur and Phosphorus ?**



Tramp Oil Myth #2

A centrifuge will solve my tramp oil problems and not remove the original emulsion product

True or False

Tramp Oil Myth #2

- A centrifuge will solve my tramp oil problems and not remove the original emulsion product

False

The oil phase of "tramp oil" is soluble to other oil-like products in the original MWF and will be removed together

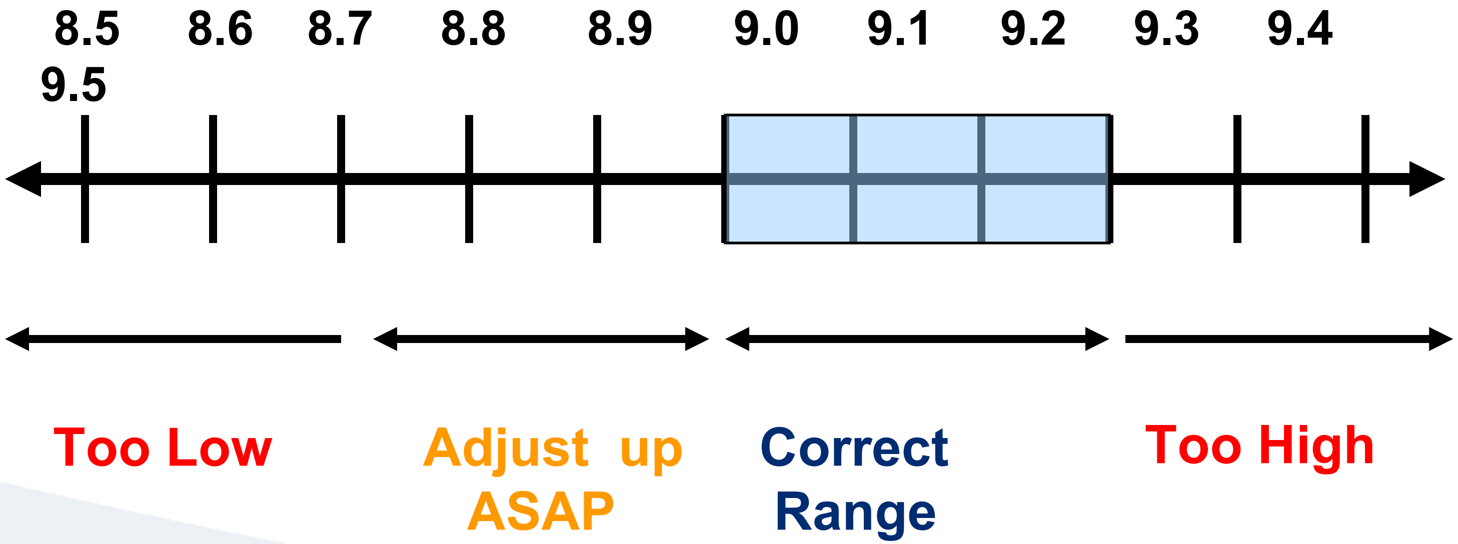
Failure Mechanism #4
Lack of pH Control

Failure to Control pH

- **Certain amines can evaporate, and pH will drop**
- **Can happen more in winter (low humidity) than summer months**
- **Dissolved CO_2 as carbonic acid will lower pH**
- **Certain microorganisms as they proliferate will release acids and thus lower pH**
- **There are acceptable operational ranges for traditional MWFs**

Failure Mechanism #4
Lack of pH Control

pH Ranges For MWF Management



Quaker Houghton
Forward Together

Failure Mechanisms #5
Lack of Control of Microorganisms

Failure to maintain an effective biological control program in your MWF

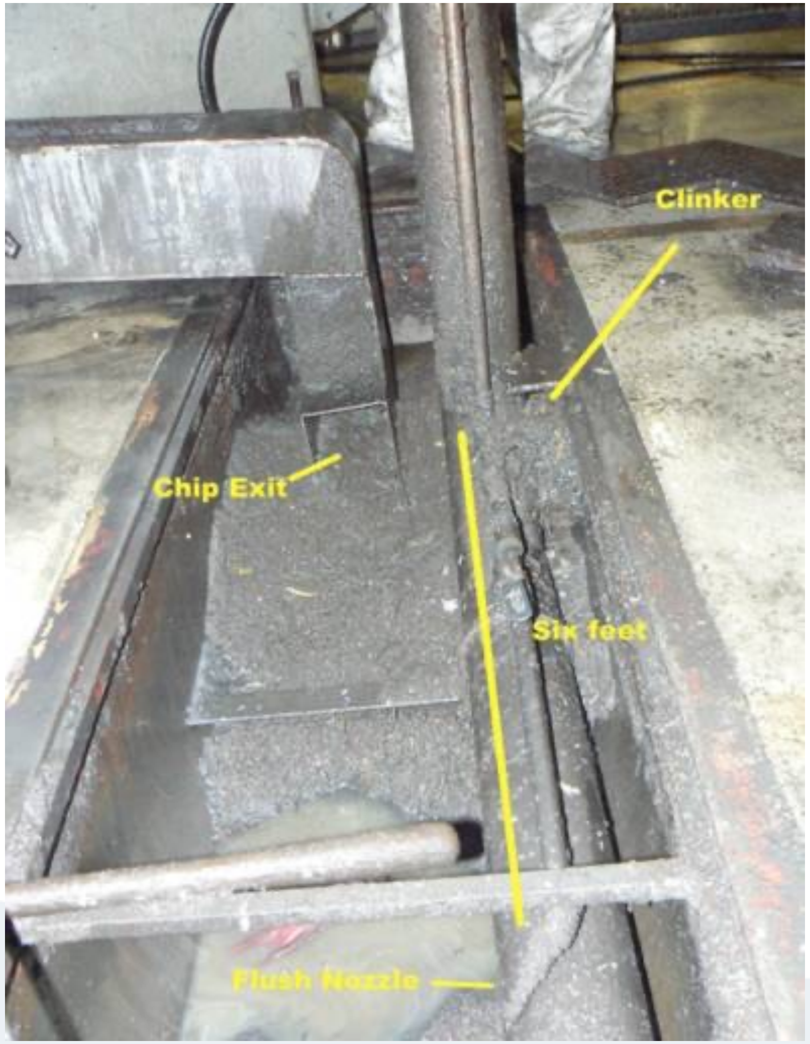
- Controlled and proper use of:
  - Antimicrobial Pesticides (i.e. biocides)

- Too little may be worse than none at all.
  - Resistant strains
- If some is good, more is not better.
  - Worker irritation
- Key Words: Biocide, concentration control

Fixing Dead Spots is Part of Your Biological Control Program

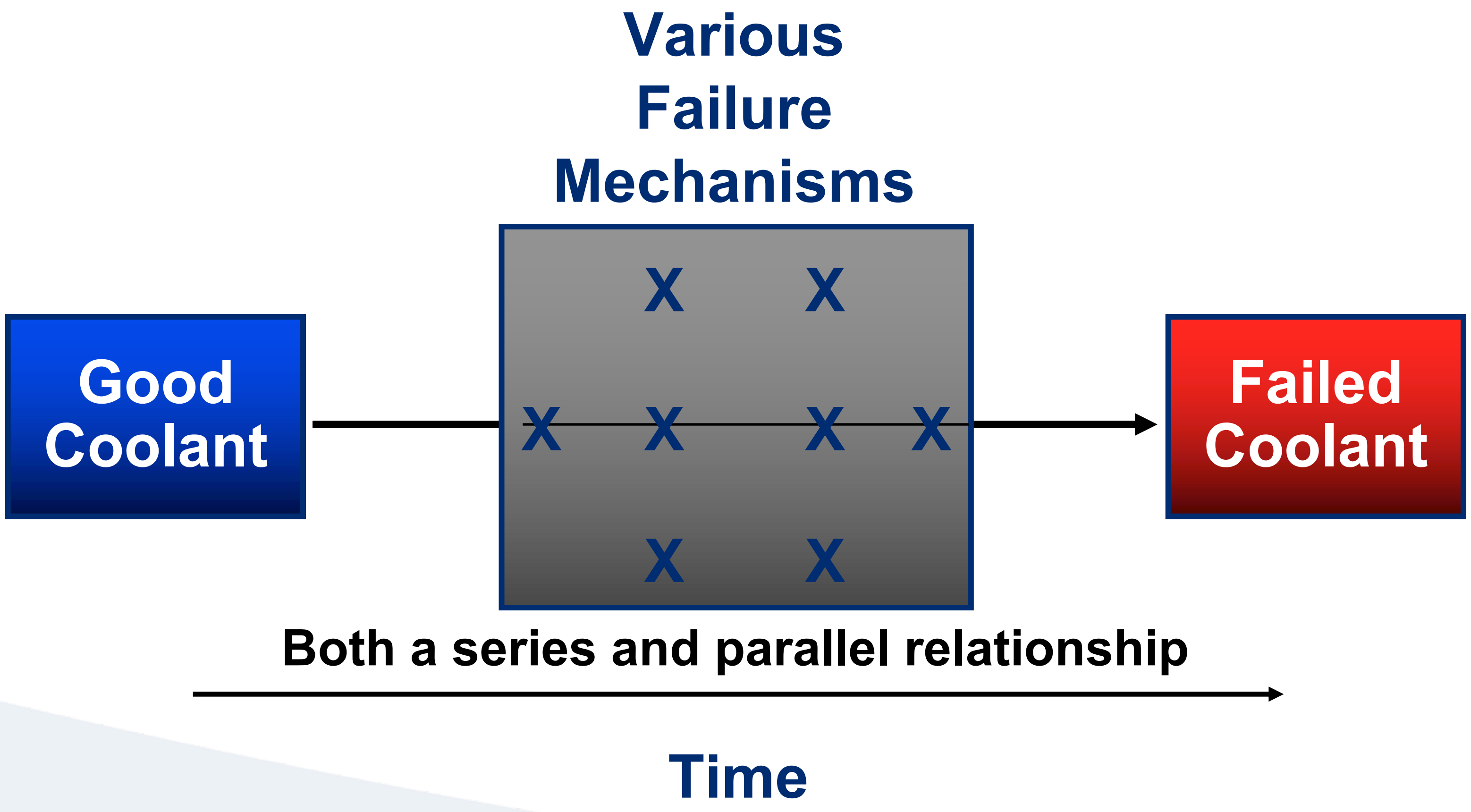
Fixing Dead Spots is Part of Your Biological Control Program

Other times you have to pull trench covers to see the dead spots

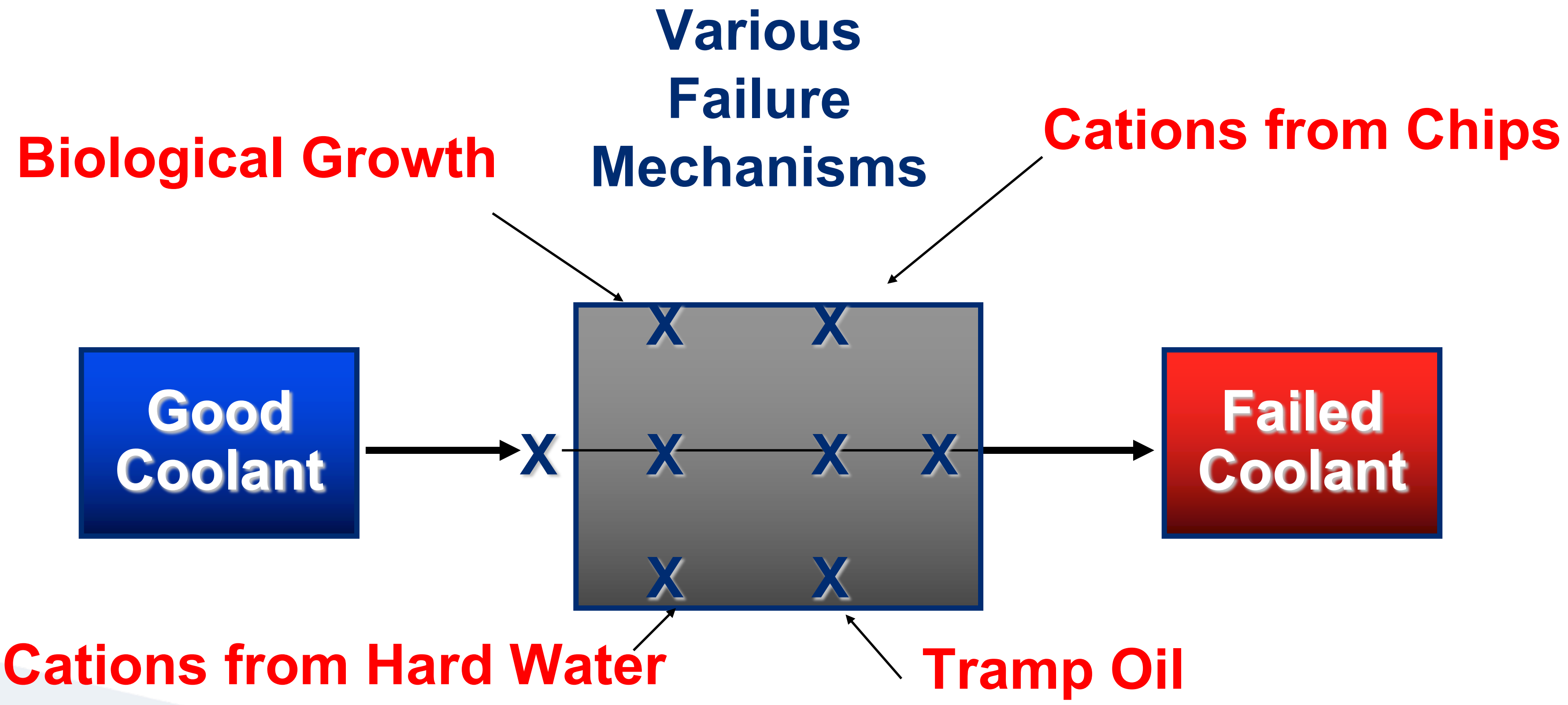


Fixing Dead Spots is Part of Your Biological Control Program

Basic Failure Model
Water Diluted Fluids



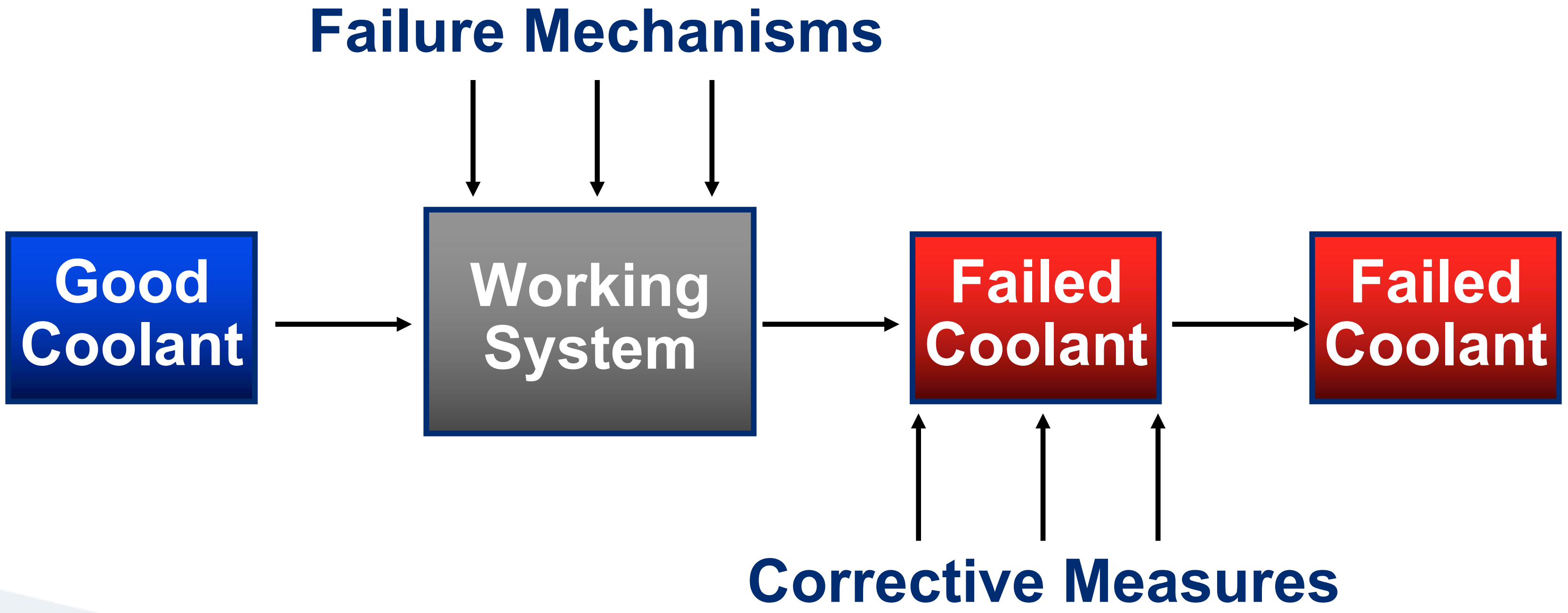
Basic Failure Model
Water Diluted Fluids



Both a series and parallel relationship, and they interact

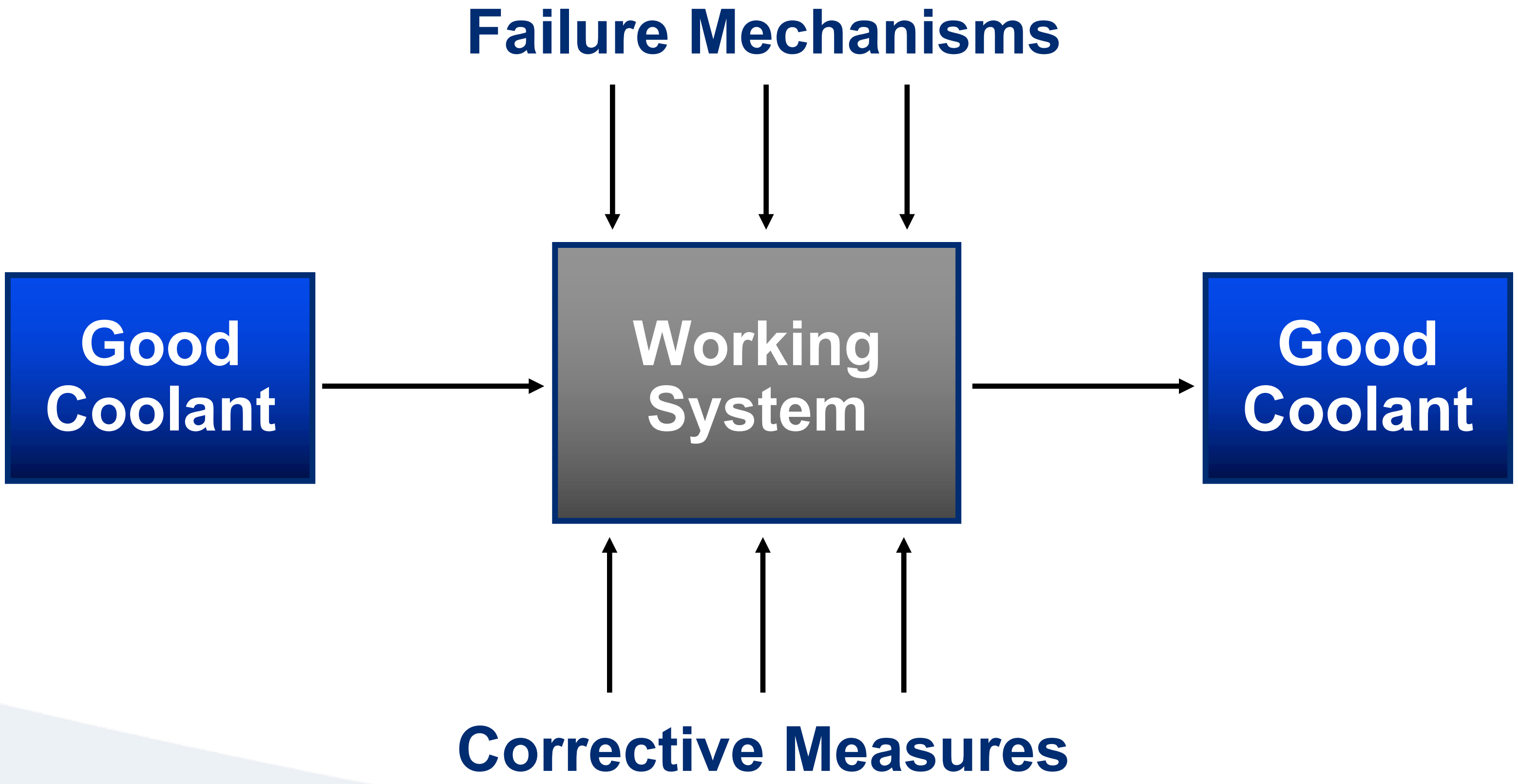
Time

Ineffective Approach

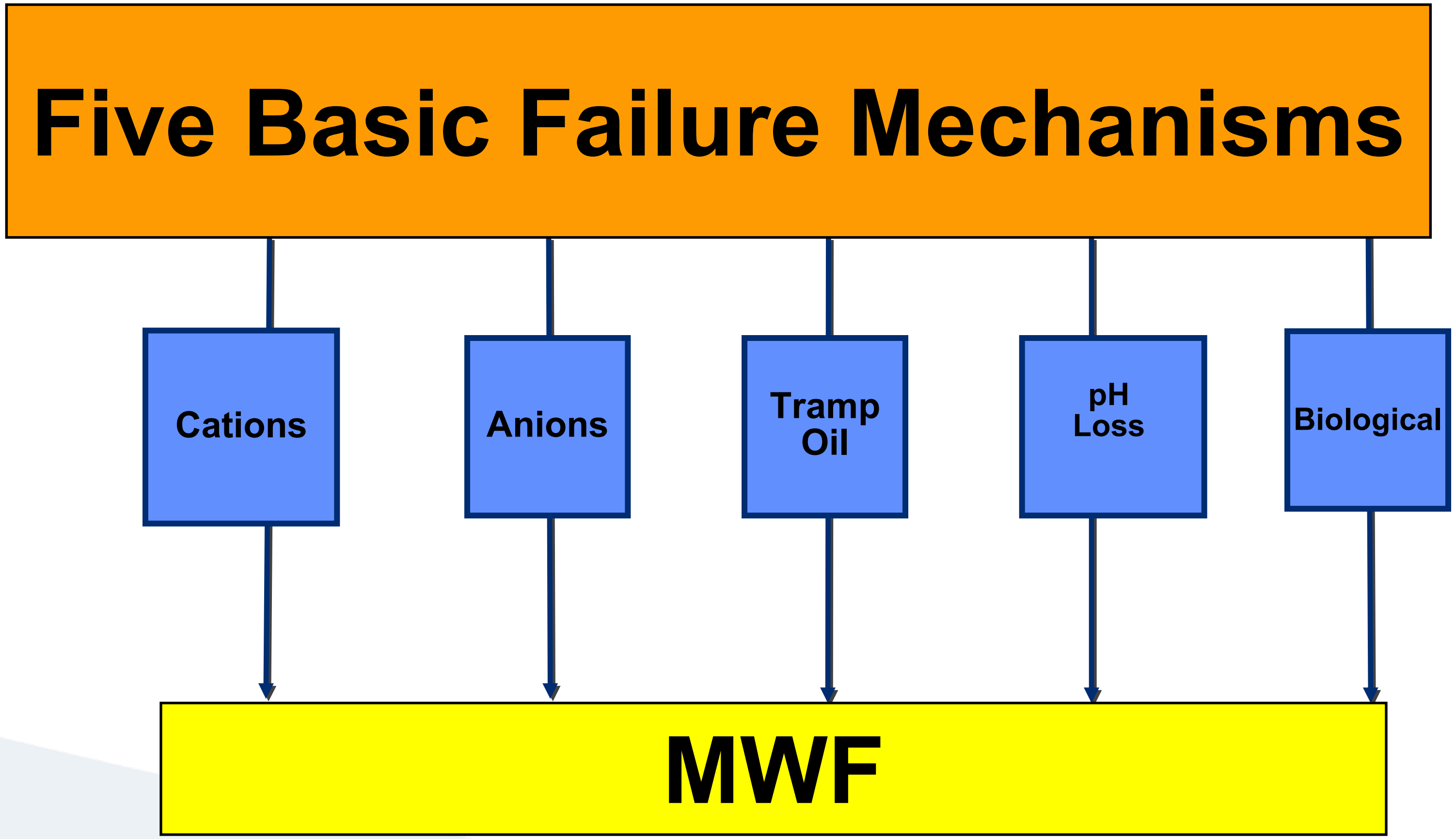


e.g. Burnt Paper Analogy

Effective Approach



Focus on Failure Mechanisms



Basic Corrective Actions

These are intended to be basic methods that an average manufacturing facility can follow.

They are not intended to correct every problem that can occur.

Counteracting Failure Mechanisms #1 Cation Attack from Metals

The Effects of the Type and Volume of Metal Fines Entering the System

- Effective filtration
- Best: Filters that are full flow, with at least 30 micron rating –

  Polyester media not polypropylene

  Ability remove tramp oil – if needed then use polypropylene

  Choose a stable fluid
- Key Point: All chemical reaction takes time
  Metal fines keep reacting

Counteracting Failure Mechanisms
#1Cation Attack from Metals
Fix Dead Spots

Counteracting Failure Mechanisms #1 & 2

Cation and Anion Attack From Water

The Effects of Hard Water

- Use low hardness and low chloride water for makeup into your coolant systems
- Best: Reverse osmosis water
- Key Point: The reaction of hard water to de-stabilize a MWF occurs very rapidly (usually in seconds)

Counteracting Failure Mechanism #3
Tramp Oil

The Effects of Hydraulic Oil and Way Oils (Tramp Oils)

- **Fix the leaks and install a <u>continuous</u> tramp oil separating oil system.**
- **Minimize the use of machine lubricants containing high amounts of de-emulsifiers and dispersants if you cannot fix the leaks.**
  - **Major Automotive OEM Approach**

Counteracting Failure Mechanism #3
Tramp Oil

Key point: The negative effects of de-emulsifiers and dispersants on cutting fluid emulsions will occur completely within 48 to 72 hours depending on:

- Type and amount of metal being machined
- Amount of tramp oil entering the system
- Basic stability of the coolant

Counteracting Failure Mechanism #3
Tramp Oil

Zinc: Can cause grief with your environmental folks

Is likely in:

Hydraulic oil

Way oil

Spindle oil

Galvanized pipe

Buckets

Counteracting Failure Mechanism #4
Loss of pH

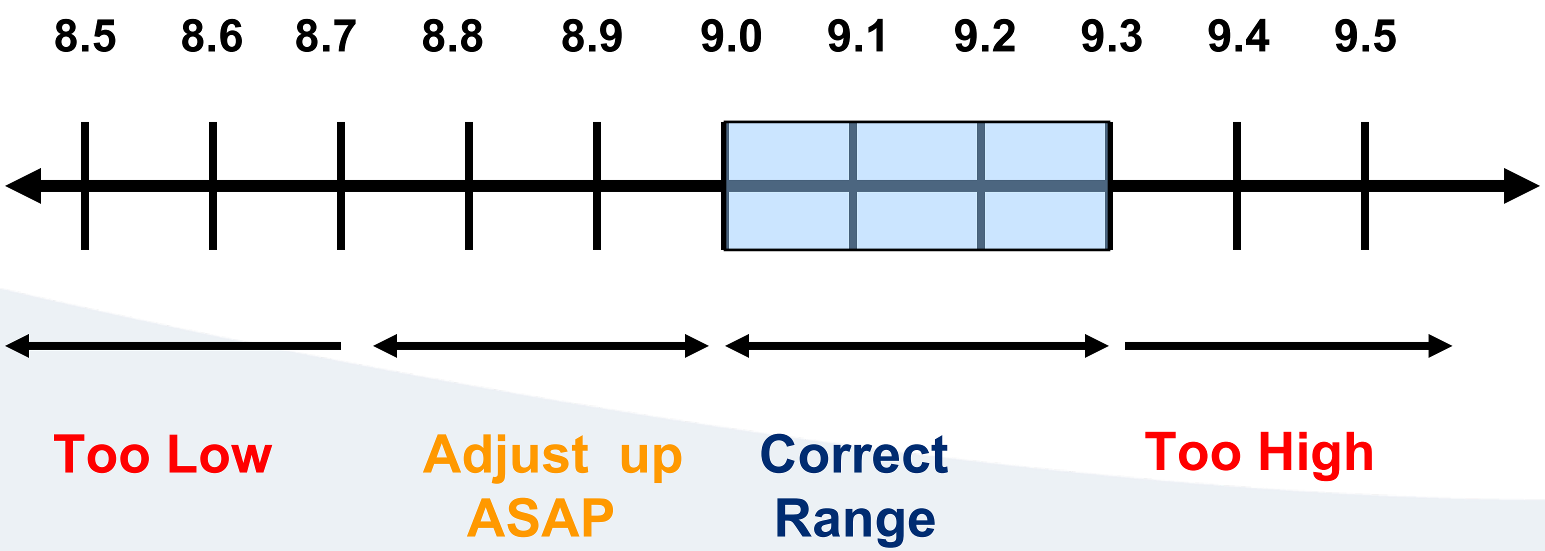
For pH Control

Amino Methyl Propanol

Primary or Tertiary Alkanolamines

such as **Monoethanolamine, Triethanolamine, Monoisopropanolamine.**

Note: Add these chemicals slowly and carefully



Counteracting Failure Mechanism #5 Biological Degradation

Controlling Microbial Activity

Selective use of antimicrobial pesticides (biocides), consult with the manufacturer or their representative.

Monitor microbe activity (use dip slides at a minimum).

If some biocide is good, more is *not* better.

Focus on dead spots

Biological Dead Spots are Your Enemy

Understanding When the Fluid Has Failed

Select a Good MWF with:

- Reserve emulsifiers
- Reserve alkalinity
- Reserve corrosion inhibition
- Good biostability

Measure emulsion stability:

- Hold MWF in a clear glass container for 24 hours, then observe separation phases.

Basic Demonstration of MWF Stability

Tramp Oil

Continuous Emulsion

Start

After 24 hours

Tramp Oil

Inverted Tramp Oil

Lost Emulsion

Metastable Emulsion

Separated Phase

Know Your Concentration

- **Determine an effective method to measure MWF concentration for your metal removing operations.**

Good:	**Refractometer**
Better:	**Acid split (good for emulsion fluids) and tramp oil split, refractometer**
Best:	**Acid split, tramp oil split, refractometer, alkalinity titration, anionic titration *, biocide titration *.**

*** Usually performed by MWF supplier or with special test kits.**

Summary - Water Diluted

MWF failure will happen…… eventually.

MWF failure can be controlled to some extent.

No MWF will last indefinitely.

Poor control of a MWF can cost you money.

Over-extending the life of a MWF can cost you money as well with loss of tool life.

Summary – Water Diluted

1. Filter fluids well – Start at 30 micron
2. Use good water - Low hardness and low chlorides
3. Remove tramp oil - Continuously remove or change tramp oil type and fix leaks
4. Control pH - Additives will be required over time
5. Use antimicrobial pesticides (biocides) properly
6. Measure stability - Jar test
7. Measure and control concentration regularly - Many methods

Thank You!

Quaker Houghton
Forward Together