WATERTECH of America, Inc.

WATERTECH U

WATER TREATMENT BOOT CAMP LEVEL I

APRIL 26TH, 2016

TODAY'S SPEAKERS

- JOE RUSSELL – PRESIDENT – 30+ YEARS OF EXPERIENCE
- TOM CHRISTMAN – VICE PRESIDENT – 35+ YEARS OF EXPERIENCE
- JEFF BODENDORFER – TERRITORY MANAGER – 4 YEARS OF EXPERIENCE
- JON TIEGS – GENERAL MANAGER – 15+ YEAR OF EXPERIENCE

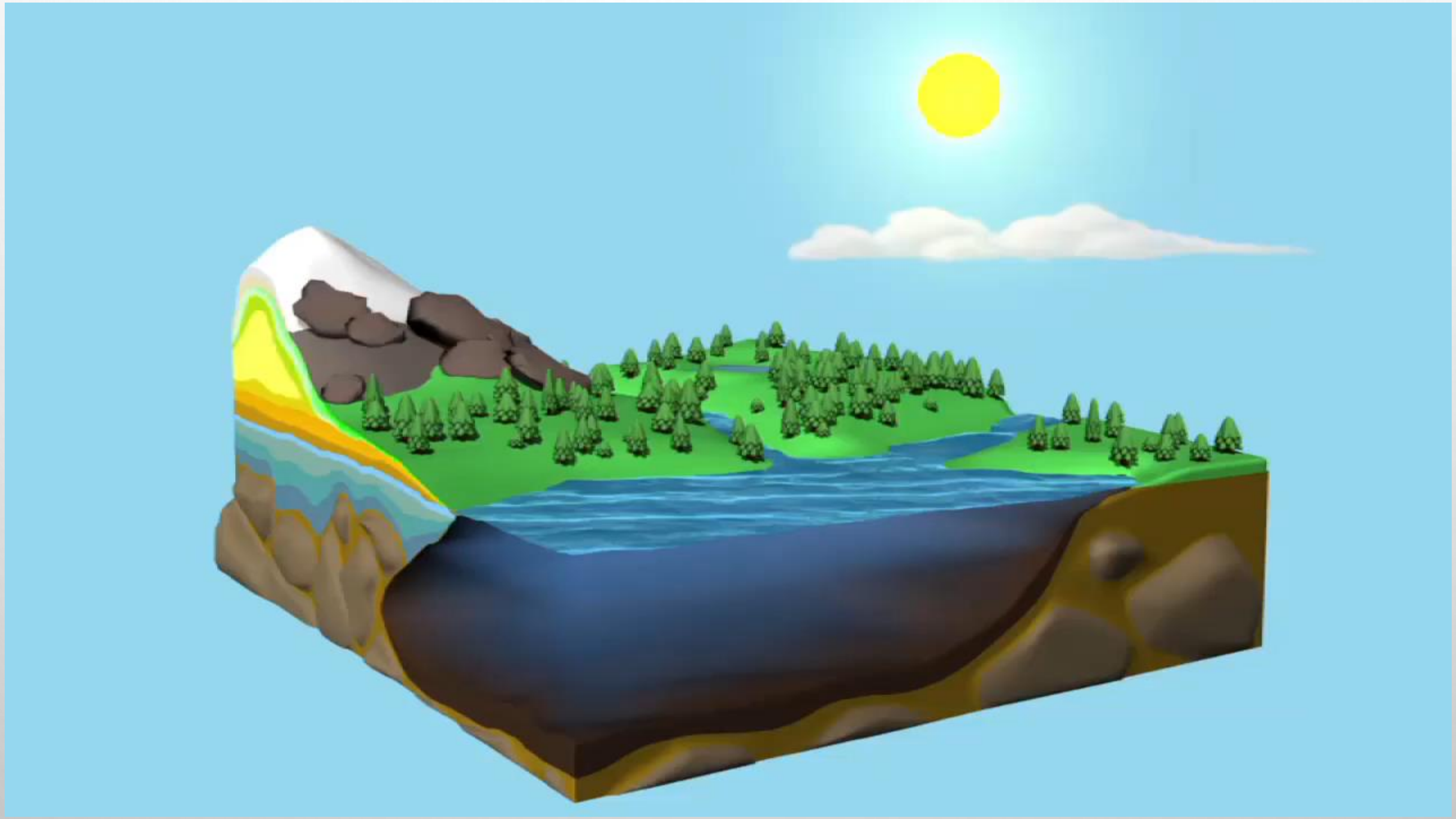
BASIC WATER CHEMISTRY - BOILERS

JOE RUSSELL, CWT

MANAGING FRESH WATER

The amount of moisture on Earth has not changed. The water the dinosaurs drank millions of years ago is the same water that falls as rain today. But will there be enough for a more crowded world?

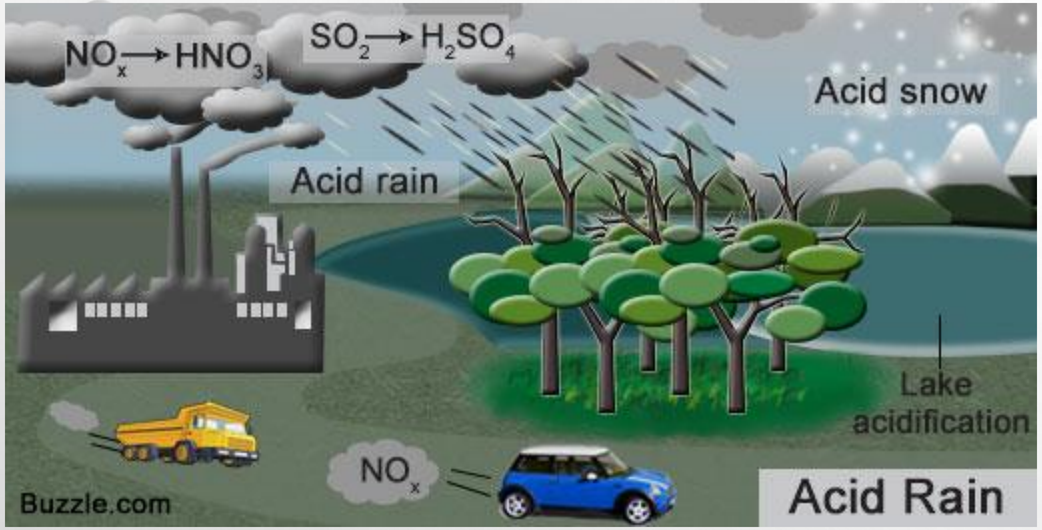
HYDROLOGIC CYCLE

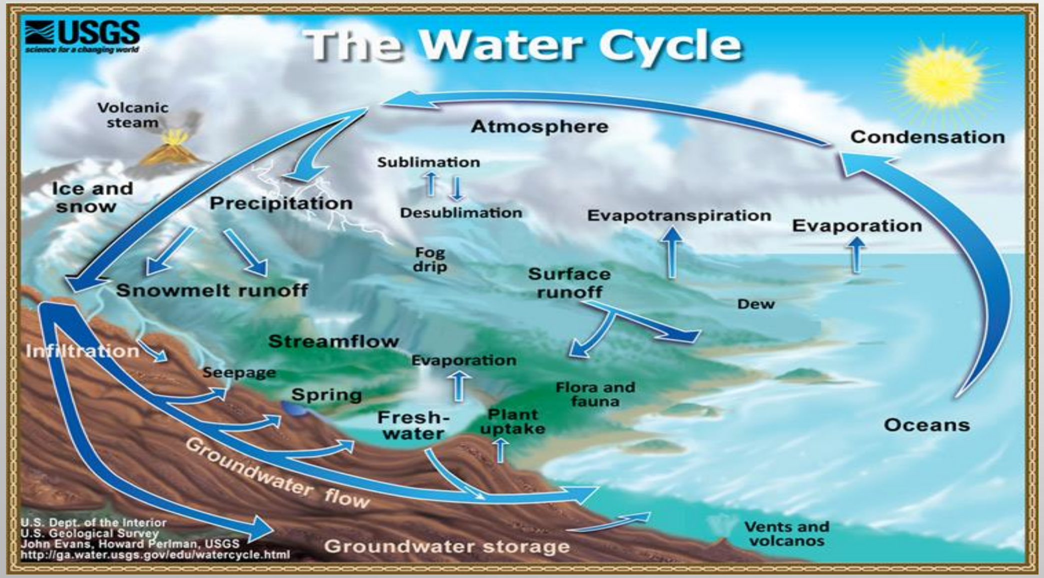


WATER - IDEAL FOR INDUSTRIAL HEATING AND COOLING NEEDS

- Relatively abundant (covers ¾ of earth's surface)
- Easy to handle and transport
- Non-toxic and environmentally safe
- Relatively inexpensive
- Exits in three (3) forms – solid(ice), liquid(water), gas(steam)
- Tremendous capacity to absorb and release heat
    - High Specific Heat
    - High Heat of Vaporization (970 B.T.U.'s/lb)
    - High Heat of fusion (143 B.T.U.'s/lb)

WATER – THE UNIVERSAL SOLVENT



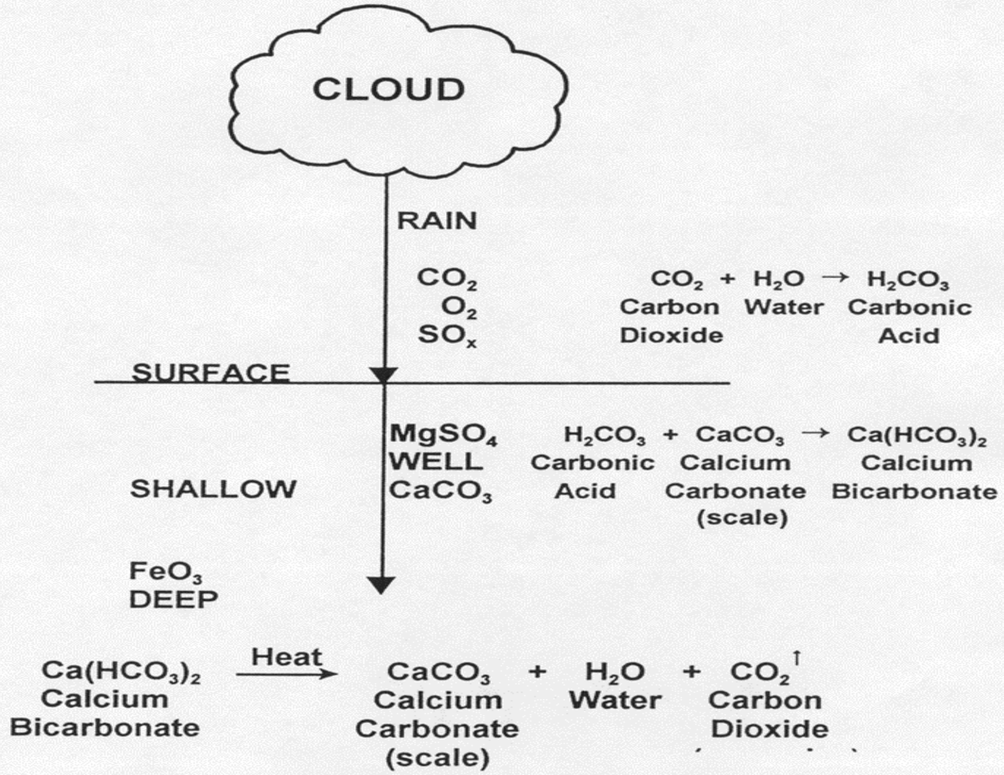


BASIC WATER CHARACTERISTICS

III. Hydrological cycle

SOLVENT PROPERTIES

WATER CYCLE



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BASIC WATER CHARACTERISTICS

Comparative example of surface and ground water characteristics

	City of Milwaukee Linnwood Plant	City of Waukesha Sunset Drive (Well #6)
Total Alkalinity ($CaCO_3$)	115	260
Aluminum	0.18	-----
Carbon Dioxide (Free)	1.47	-----
Calcium Hardness ($CaCO_3$)	89	205
Chlorides	9.1	2.0
Copper	0.013	-----
Fluoride ($CaCO_3$)	0.21	1.33
Hardness, Total ($CaCO_3$)	138	316
Iron	0.01	0.34
Magnesium ($CaCO_3$)	49	111
Manganese	0.016	0.04
Nitrates	0.19	0.5
Oxygen, Dissolved (@ 68°F)	18.9	-----
pH	8.23	8.0
Silica	1.03	7.0
Sodium	6.3	6.0
Sulfate	27.5	64
Conductivity (mmhos)	295	627

SO WHY ALL THE FUSS??

- BOILERS WILL EXPLODE WITH IMPROPER WATER TREATMENT/MANAGEMENT
- PREMATURE EQUIPMENT FAILURES AND UNSCHEDULED DOWNTIME WILL RESULT IF WATER SYSTEMS ARE NOT PROPERLY MAINTAINED AND CHEMICALLY TREATED.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) & AMERICAN BOILER MANUFACTURER (ABMA) GUIDELINES

Watertech of America, Inc. | WATER MANAGEMENT CHEMICALS | BOILER APPLICATIONS DATA

ASME GUIDELINES
TABLE 2
SUGGESTED WATER QUALITY LIMITS[a]

Boiler Type: Industrial watertube, high duty, primary fuel fired, drum type
Makeup Water Percentage: Up to 100% of feedwater
Conditions: No superheater, turbine drives, or process restriction on steam purity
Saturated Steam Purity Target[7]: 1.0 mg/l (ppm) TDS maximum

Drum Operating Pressure	MPa (psig)	0-2.07 (0-300)	2.08-3.10 (301-600)
Feedwater[3]			
Dissolved oxygen (mg/l O_2) measured before chemical oxygen scavenger addition[1]		<0.04	<0.04
Dissolved oxygen (mg/l O_2) measured after chemical oxygen scavenger addition[2]		<0.007	<0.007
Total iron (mg/l Fe)		<0.10	<0.050
Total copper (mg/l Cu)		<0.05	<0.025
Total hardness (mg/l as $CaCO_3$)		<0.5	<0.3
pH range @ 25°C		7.0-10.5	7.0-10.5
Nonvolatile TOC (mg/l C)[6]		<1	<1
Oily matter (mg/l)		<1	
Boiler Water			
Silica (mg/l SiO_2)		<150	<90
Total alkalinity (mg/l as $CaCO_3$)		<1000[5]	<850[5]
Free hydroxide alkalinity (mg/l as $CaCO_3$)[4]		Not Specified	Not Specified
Specific conductance (μS/cm) (μmho/cm) at 25°C without neutralization		<8000[5]	<6500[5]

NOTES FOR TABLE 2:

[1] Value in table assumes existence of a deaerator.

[2] Chemical deaeration must be provided in all cases but especially if mechanical deaeration is nonexistent or inefficient.

[3] Boilers with relatively large furnaces, large steam release space and internal chelant, polymer, and/or antifoam treatment can often tolerate higher levels of feedwater impurities than those in the table and still achieve adequate deposition control and steam purity. Removal of these impurities by external pretreatment is always a more positive solution. Alternatives must be evaluated as to practicality and economics in each individual case. The use of some dispersant and antifoam internal treatment is typical in this type of boiler operation so it can tolerate higher feedwater hardness than the boilers in Table 1.

[4] Minimum level of OH^- alkalinity must be individually specified with regard to silica solubility and other components of internal treatment.

[5] Alkalinity and conductance values consistent with steam purity target. Practical limits above or below tabulated values can be established for each case by careful steam purity measurements.

[6] Nonvolatile TOC is that organic carbon not intentionally added as part of the water treatment regime.

[7] Target value represents steam purity which should be achievable if other tabulated water quality values are maintained. The target is not intended to be nor should it be construed to represent a boiler performance guarantee.

SO HOW DOES THIS WATER MEET THESE GUIDELINES?

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Total copper (mg/l Cu)		<0.05	<0.025
Total hardness (mg/l as $CaCO_3$)		<0.5	<0.3
pH range @ 25°C		7.0-10.5	7.0-10.5
Nonvolatile TOC (mg/l C)[6]		<1	<1
Oily matter (mg/l)		<1	
Boiler Water			
Silica (mg/l SiO_2)		<150	<90
Total alkalinity (mg/l as $CaCO_3$)		<1000[5]	<850[5]
Free hydroxide alkalinity (mg/l as $CaCO_3$)[4]		Not Specified	Not Specified
Specific conductance (µS/cm) (µmho/cm) at 25°C without neutralization		<8000[5]	<6500[5]

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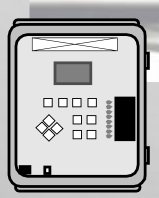
WATER USE AND YOUR BOILER WATER SYSTEM

WATERTECH of America, Inc.

Before

Controller



Setpoint

3,500 uS

= 9.7 Cycles

Annual Make Up	Annual Blowdown
23.77 MG	5.77 MG
$45,170	$15,010

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850 uS
Make Up

32,120 GPD

Condensate

119,565 GPD

79%

Heat Exchanger

Steam

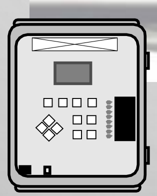
After

50,000 #/hr
Steaming Rate

180 uS
Feed Water

151,686 GPD

Controller



Setpoint

3,500 uS

= 19.4 Cycles

Annual Make Up	Annual Blowdown
11.24 MG	2.73 MG
$21,360	$7,098

Blowdown

7,801 GPD

	Make Up Flow	Make Up Cost	Blowdown Flow	Blowdown Cost
9.4 Cycles	23.77 MG	$45,170	5.77 MG	$15,010
19.7 Cycles	11.24 MG	$21,360	2.73 MG	$7,098
Savings	12.53 MG	$23,810 (-52.7%)	3.04 MG	$7,912 (-52.7%)

Fuel Savings = $40,000 / year

Chemical Savings = $20,000 / year

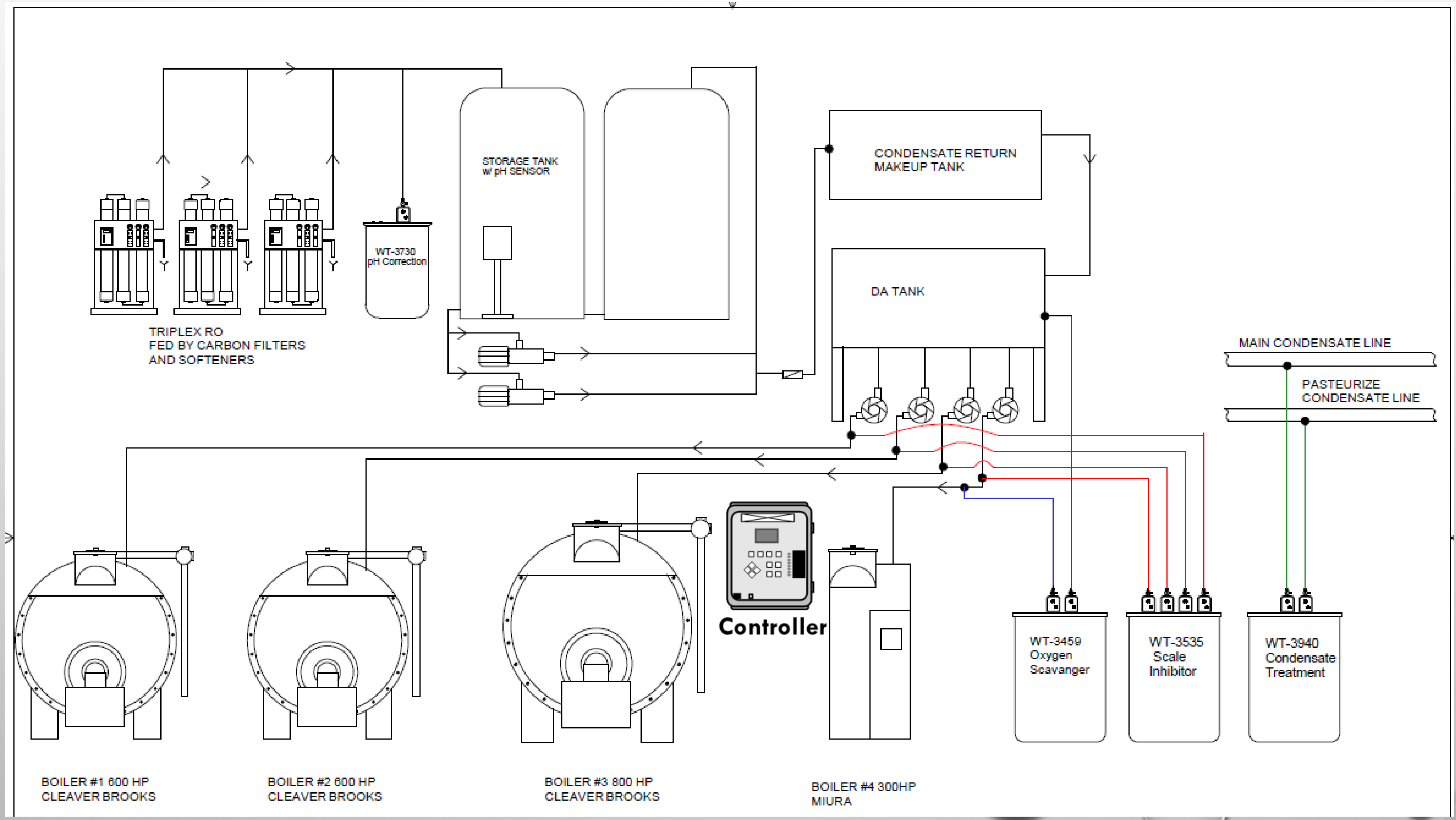
Total Savings = $92,000 per year

125 psi boiler operating at 80% efficiency, 2012 city of Milw. Water cost, $4.50/MSCF gas cost, 160°F condensate temp.,

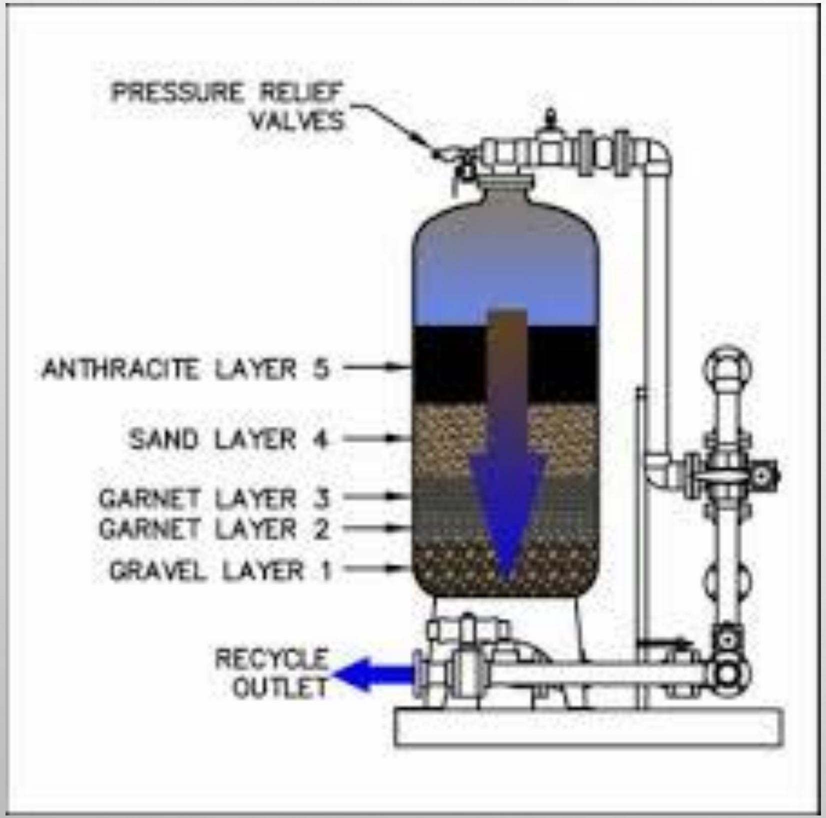
TYPICAL BOILER SYSTEM LAYOUT

JEFF BODENDORFER

TYPICAL BOILER SYSTEM LAYOUT



FILTRATION



PRESSURE RELIEF VALVES
ANTHRACITE LAYER 5
SAND LAYER 4
GARNET LAYER 3
GARNET LAYER 2
GRAVEL LAYER 1
RECYCLE OUTLET

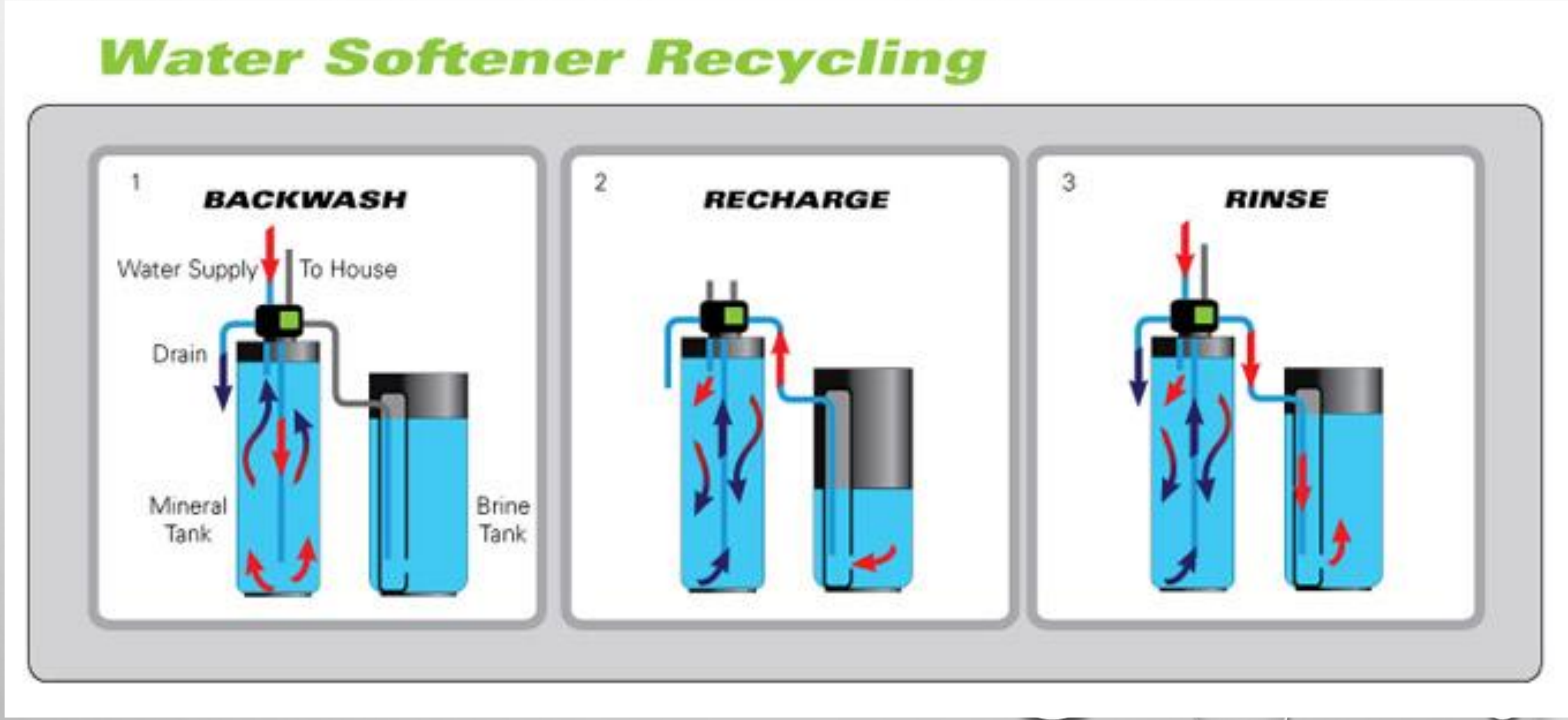
Activated Carbon

pep

SOFTENERS

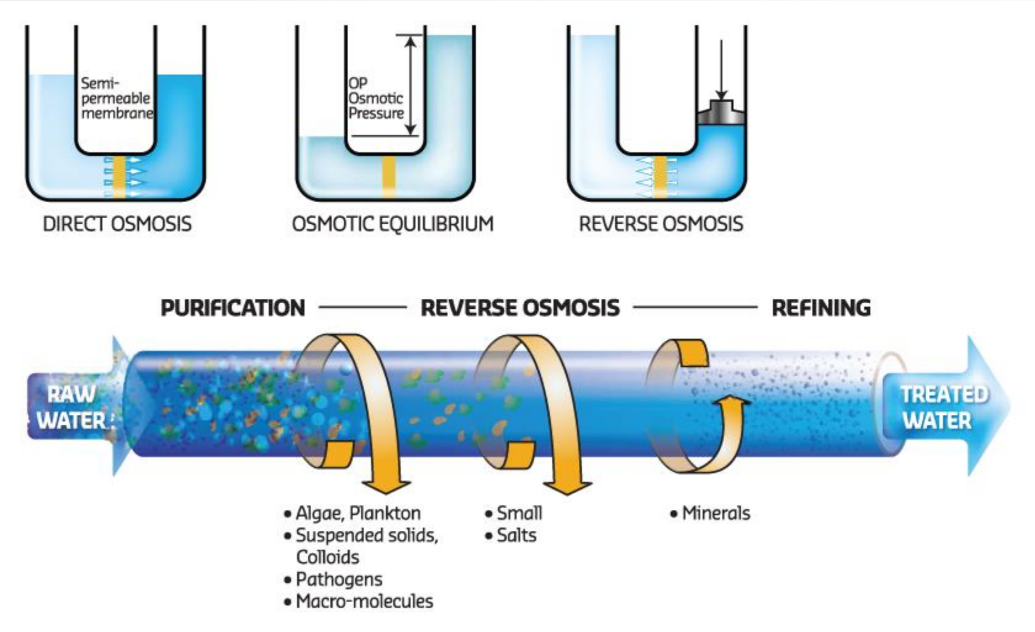
- WHAT IS THE MAIN FUNCTION OF WATER SOFTENERS?
- WHAT INFORMATION DO YOU NEED TO KNOW WHEN SIZING SOFTENERS?
- DON'T RUN ON HARD WATER!

SOFTENER REGENERATION



REVERSE OSMOSIS

- WHAT ARE THE BENEFITS TO USING RO WATER FOR BOILER FEED WATER?
- CYCLES OF CONCENTRATION
- BETTER WATER QUALITY (TOTAL DISSOLVED SOLIDS AND ALKALINITY REDUCTION) = BETTER WATER QUALITY



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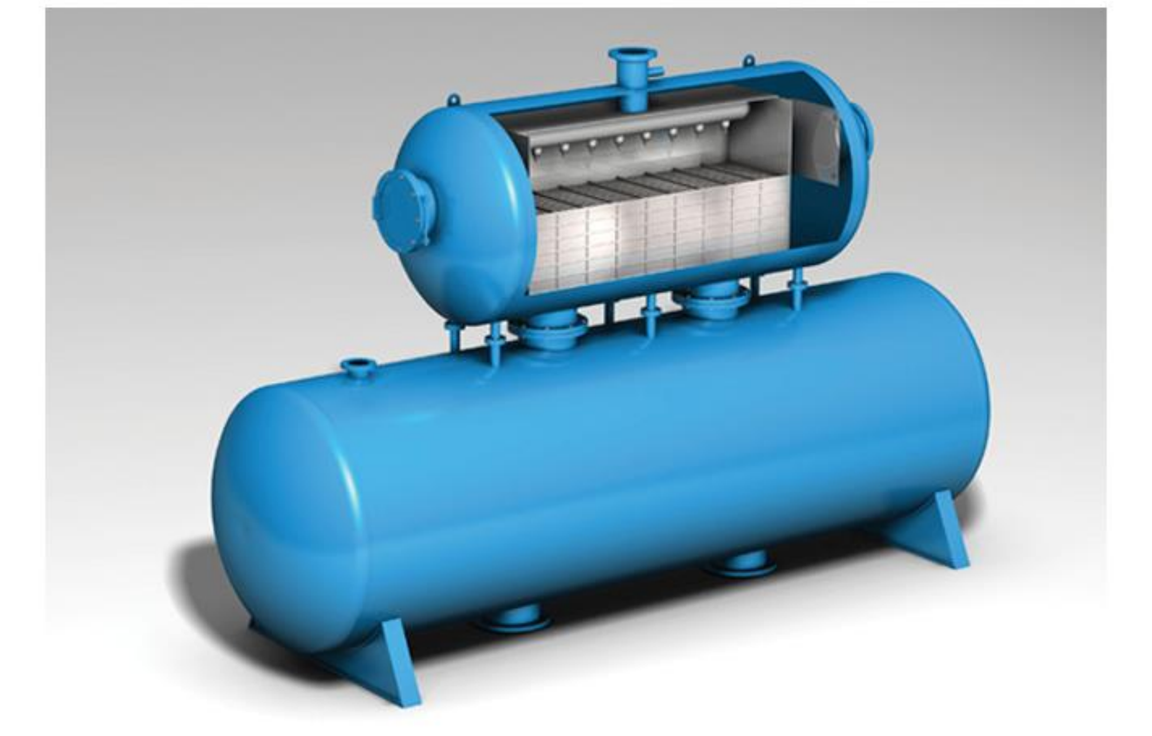
DEALKALIZERS AND DEIONIZERS

- DEALKALIZER FOR ALKALINITY REDUCTION
- DEMINERALIZER FOR REMOVAL OF BOTH ANIONS AND CATIONS

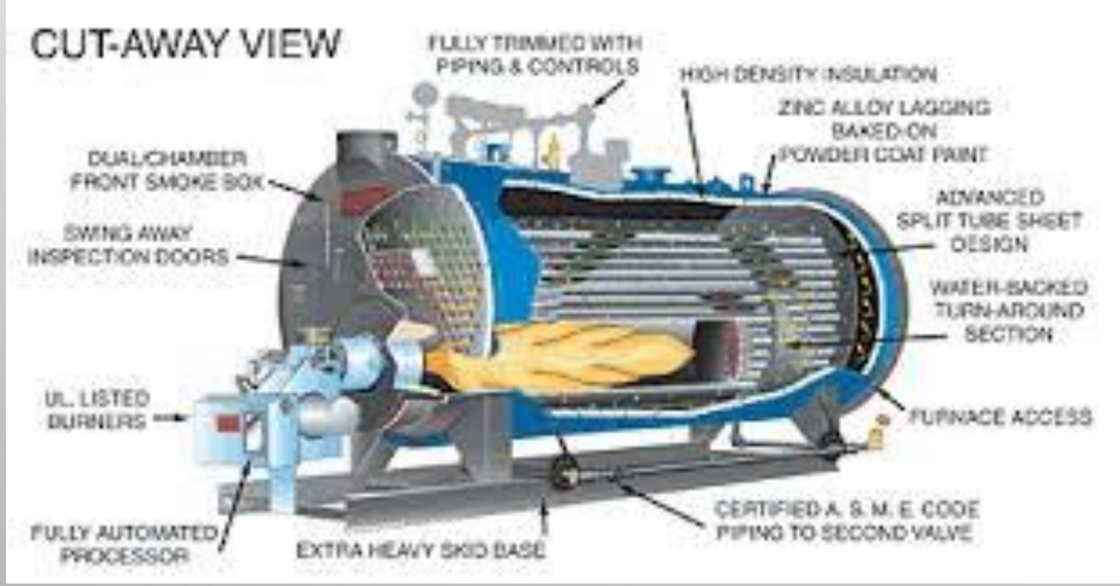
DEAERATOR VS. FEEDWATER TANK

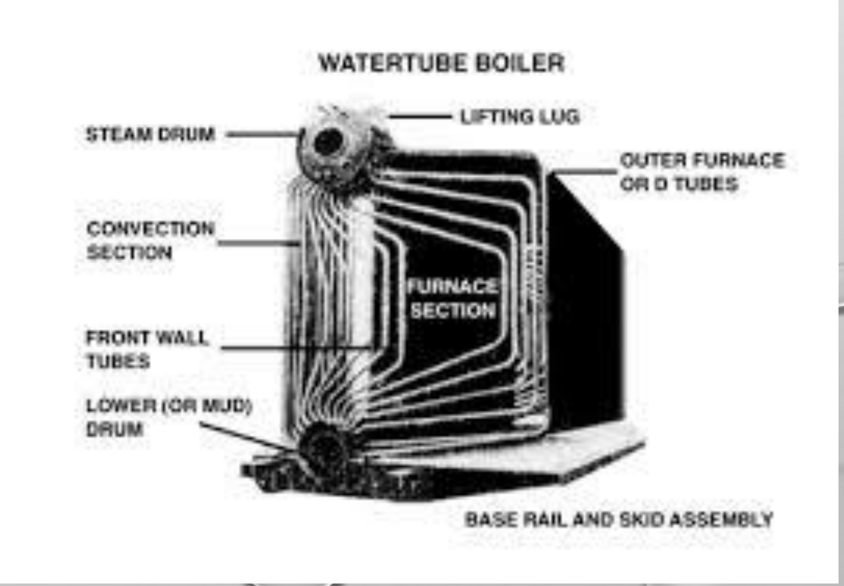
- WHAT IS THE MAJOR DIFFERENCE BETWEEN A DEAERATOR AND A FEEDWATER TANK?
  - MUCH LOWER OXYGEN LEVELS
- WHAT ARE THE BENEFITS OF USING A DEAERATOR OVER A FEEDWATER TANK?
  - REDUCE CHEMICAL AND ENERGY USAGE, REDUCE EXPANSION AND CONTRACTION



BOILERS

- WHAT TYPE OF BOILERS ARE THERE?
  - FIRETUBE
  - WATERTUBE
- WHAT ARE THE BOILERS WORST ENEMIES?
  - SCALE
  - CORROSION





HOT WATER BOILERS AND LOOPS

- COMMON FOR COMFORT HEATING APPLICATIONS AND SMALLER PROCESSES IN PLANTS
- WHAT IS IMPORTANT TO PROTECTING THE HOT WATER BOILER AND PIPING SYSTEM?

BASIC BOILER TREATMENT PROGRAMS

TOM CHRISTMAN

BASIC BOILER TREATMENT PROGRAMS

1. **OXYGEN SCAVENGER –** CORROSION CONTROL
2. **INTERNAL TREATMENT PROGRAM –** DEPOSIT CONTROL
3. **CONDENSATE TREATMENT –** CORROSION CONTROL
4. **MISCELLANEOUS –** ALKALINITY BUILDERS, ANTIFOAM

BASIC INTERNAL BOILER PROGRAMS

- **OXYGEN SCAVENGER**
  - SULFITE
  - DEHA, ERITHORBATE, HYDROQUINONE, HYDRAZINE, CARBOHYDRAZIDE, MEKOR
  - FEED TO STORAGE SECTION OF THE DA / FEEDWATER TANK BELOW THE WATER LINE
  - MAINTAIN A CONSTANT **RESIDUAL** OF OXYGEN SCAVENGER

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O2 SCAVENGER PERFORMANCE MONITORING

- MONITOR YOUR DA / FEEDWATER TANK PRESSURE AND TEMPERATURE
- WATCH SCAVENGER CONCENTRATIONS

Type	Component	Test Name	Avg	# Days	# Tests	# High	# Low	% in Range
	Boiler 3	Sulfite, ppm	41	213	82	6	1	91.46%

INTERNAL TREATMENTS

- **INTERNAL DEPOSIT INHIBITOR**
  - BLENDS OF POLYMERS, DISPERSANTS, SEQUESTRANTS, PHOSPHATE, CHELANTS
  - CONTROL OF DEPOSITS OF HARDNESS SCALES, IRON, COPPER, SILICA
  - FEED POINT VARIES DEPENDING ON THE TREATMENT PROGRAM AND WATER QUALITY
  - VARIOUS TEST METHODS TO DETERMINE ACTUAL CONCENTRATION IN BOILER WATER
- **RECOMMENDATIONS**
  - DON'T RELY ON INTERNAL TREATMENT TO DO ALL THE WORK
    - PROPERLY OPERATED PRETREATMENT EQUIPMENT IS CRITICAL

Boiler scaling on boiler tubes in composite boiler

CONDENSATE LINE CORROSION CONTROL

- **CARBONIC ACID ATTACH – LOW PH**
  - FROM MAKEUP WATER ALKALINITY ---- CARBON DIOXIDE = C02
  - REMOVE THE CARBONATE ALKALINITY IN THE MAKEUP - PROPER PRETREATMENT
- **OXYGEN ATTACK**

STEAM / CONDENSATE TREATMENTS

- **NEUTRALIZING AMINES**
  - VOLATILE AMINES USED TO RAISE THE PH OF CONDENSATE TO PREVENT ACIDIC ATTACK
  - USUALLY A BLEND OF 2-4 DIFFERENT AMINES THAT PROVIDE TOTAL SYSTEM COVERAGE
- **VOLATILE OXYGEN SCAVENGERS**
  - USED TO PREVENT OXYGEN CORROSION FROM AIR INTRUSION INTO CONDENSATE SYSTEM

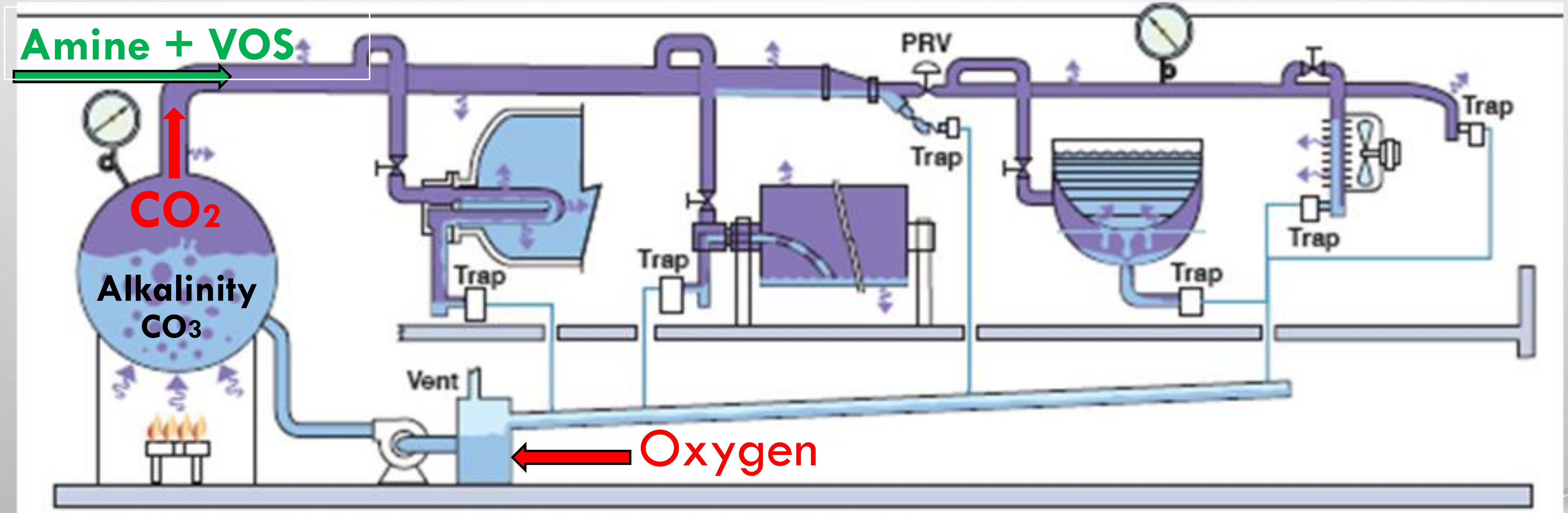


FIGURE 1. Illustration of distribution system with boiler, pipes, traps, etc.

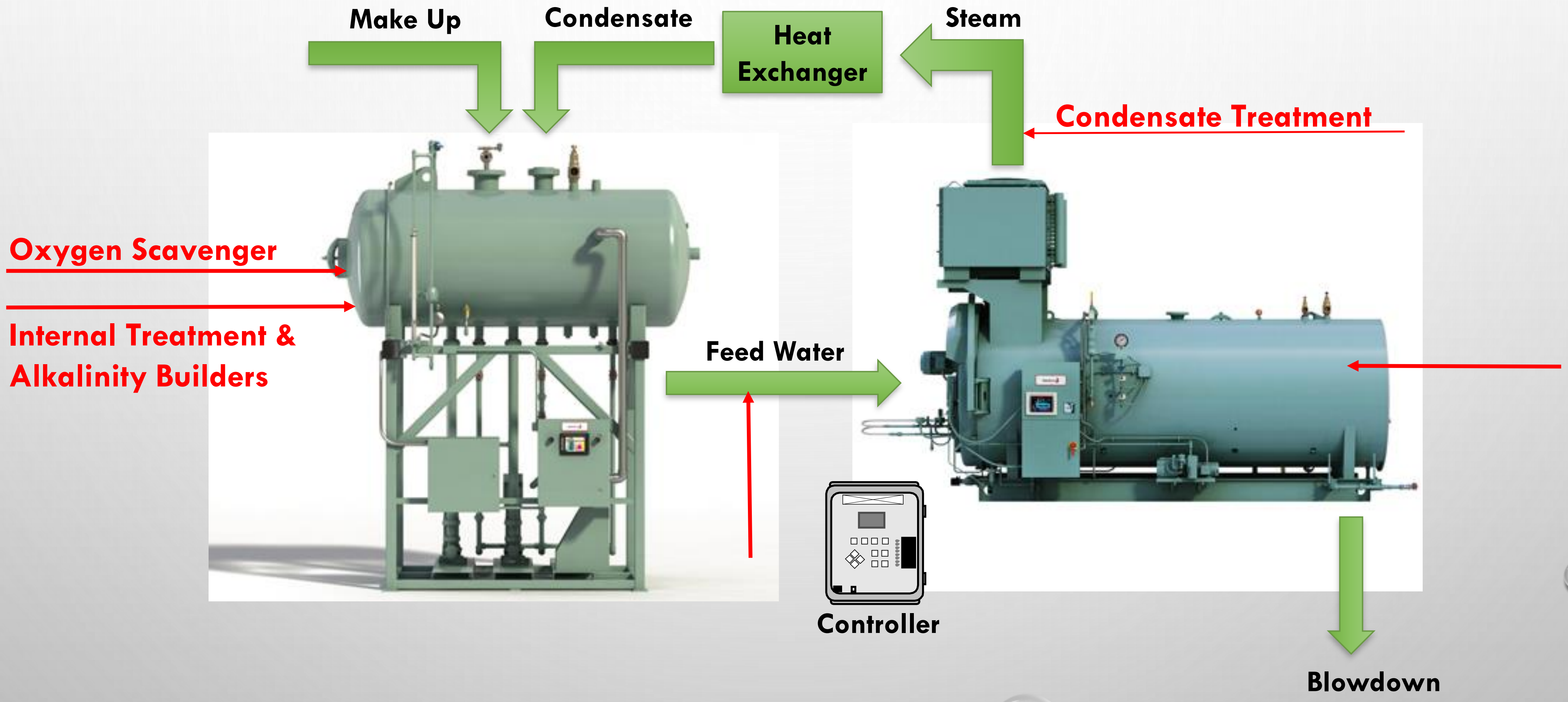
OXYGEN CONTROL IN CONDENSATE SYSTEMS

- **CAUSES AND TREATMENTS**
  - ENTERS THROUGH CONDENSATE RECEIVERS, VACUUM PUMPS, PROCESS SYSTEMS
  - TREATED USING VOLATILE OXYGEN SCAVENGERS (V.O.S.) SUCH AS DEHA, HYDROQUINONE, MEKOR, AND FILMING AMINES
  - BLENDED AMINES AND V.O.S.
- **MONITORING**
  - WATCH IRON AND COPPER CONCENTRATIONS
  - MONITOR PH LEVELS BECAUSE LOW PH LEVELS AND OXYGEN ACCELERATE CORROSION RATES
  - MONITOR VOS CONCENTRATION

MISC. CHEMICALS

- **ALKALINITY BUILDER**
  - CAUSTIC SODA FED TO THE DA / FEEDWATER TANK
- **ANTIFOAM**
- **SINGLE DRUM TREATMENTS**

TYPICAL BOILER SYSTEM CHEMICAL FEED POINTS



BASIC WATER CHEMISTRY – COOLING TOWERS

JOE RUSSELL, CWT

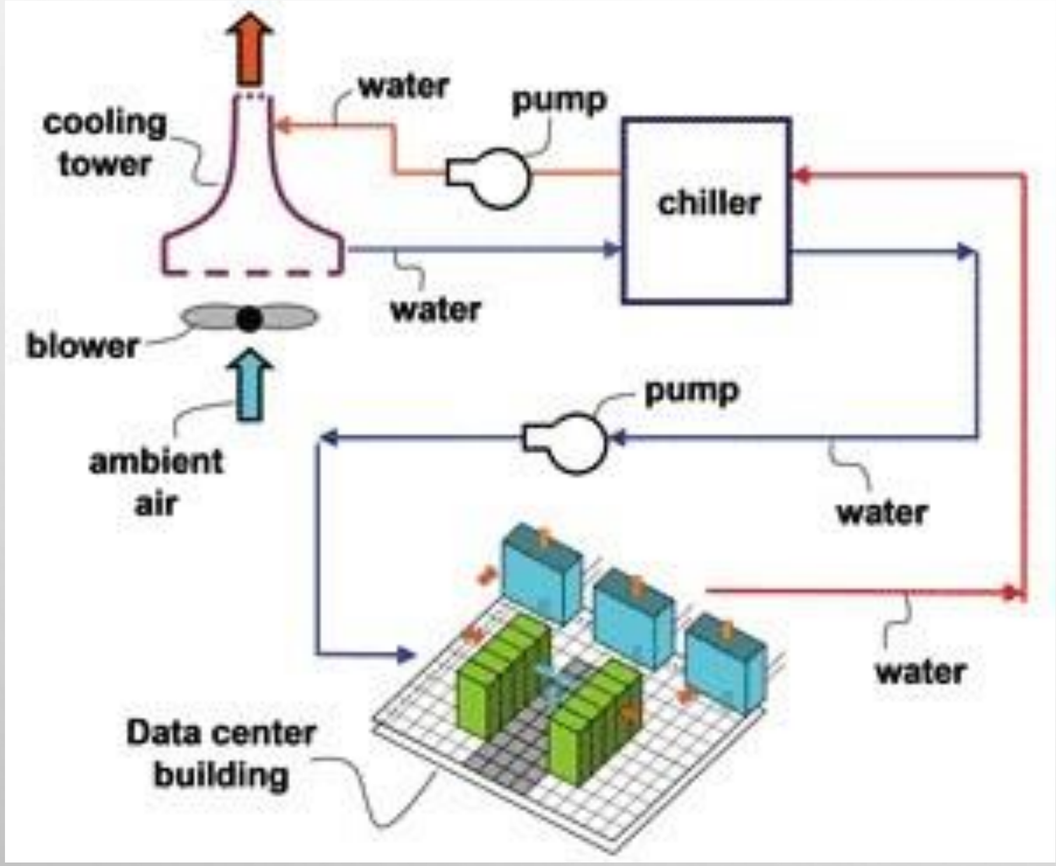
WATERTECH of America, Inc.

THE LIFE BLOOD OF THE PLANT

Approximately 70% of a plants water use is for cooling, 20% for process and 10% for other uses.

Cooling towers provide the most efficient means of rejecting heat from open recirculating cooling water systems.

THE PROCESS OF EVAPORATIVE COOLING



- Circulating cooling water, after picking up heat from the process heat exchangers , passes through the tower.
- Evaporation provides most of the cooling as the recycled water passes through the tower.
- As a result of evaporation, the dissolved solids in the water become concentrated.
- The rate of water discharge, blowdown, stabilizes the dissolved solids content of the water.
- The evaporative process also absorbs gasses from the air, particulate matte, nutrients - for biological growth- and reduces the solubilities of the solids remaining in the circulating water.

WATER – THE UNIVERSAL SOLVENT

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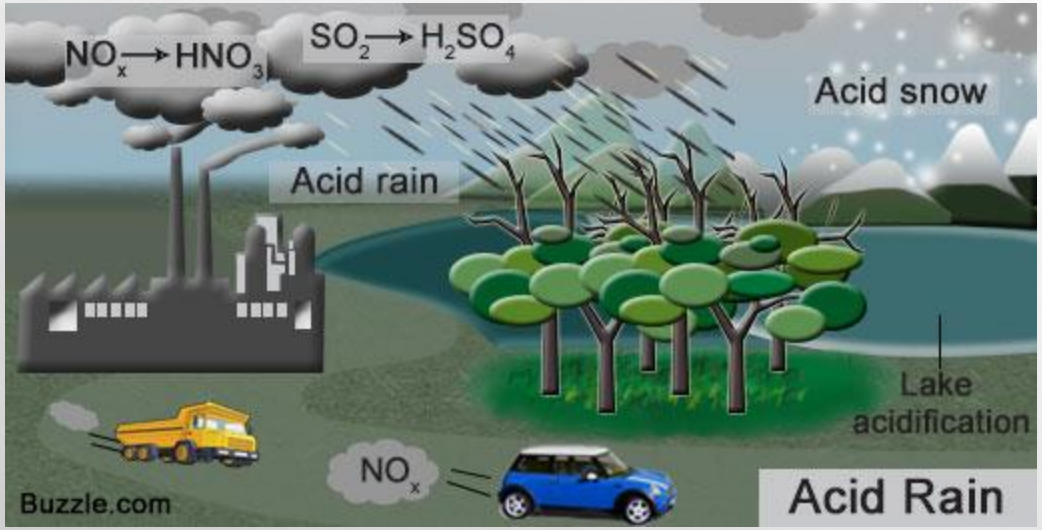

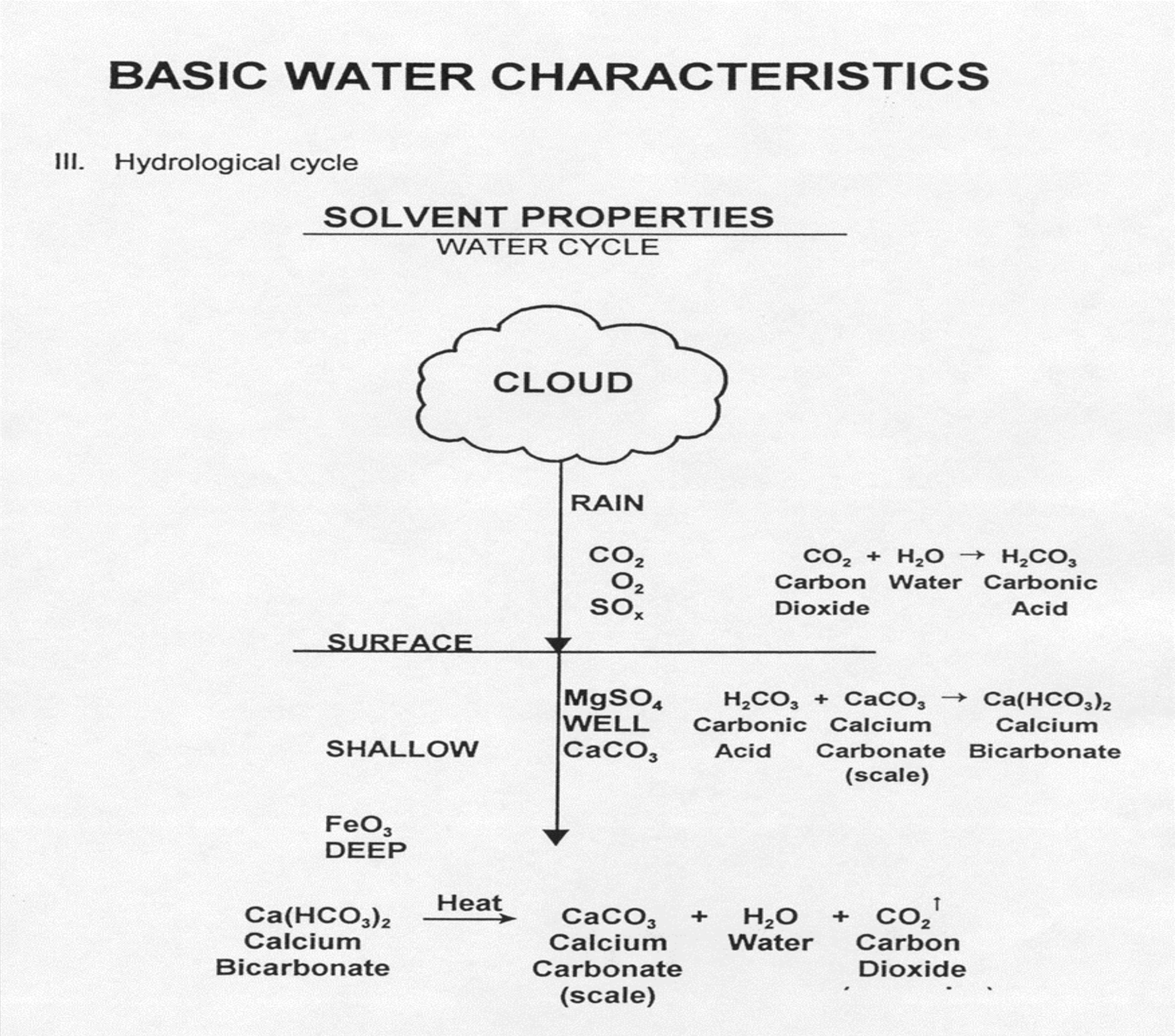

TYPICAL SOURCES OF COOLING TOWER MAKE UP

- WELL WATER - SCALING
- MUNICIPAL SOURCE WATER - SCALING
- WASTE WATER -SCALING, CORROSIVE, FOULING
- REUSE WATER (RO CONCENTRATE) - SCALING
- PROCESS CONDENSATE (COW WATER) – CORROSIVE, FOULING

  - EACH POSES DIFFERENT CHALLENGES
  - PRETREATMENT MAY OR MAY NOT BE NECESSARY
  - EACH SOURCE OF WATER WILL POSE UNIQUE CHALLENGES

LANGELIER SCALING INDEX – HOW TO PREDICT A WATER'S SCALE OR CORROSION TENDENCIES

- LSI PREDICTS THE SCALING/CORROSIVE TENDENCY OF WATER
- GOAL IS TO KEEP LSI BELOW 2.5
- INPUTS ARE TEMPERATURE, pH, CALCIUM HARDNESS, TOTAL ALKALINITY AND TOTAL DISSOLVED SOLIDS.
- RUN CYCLES OF CONCENTRATION AS HIGH AS POSSIBLE BUT KEEP THE LSI BELOW 2.5
- 4 – 5 CYCLES OF CONCENTRATION IS OPTIMUM.

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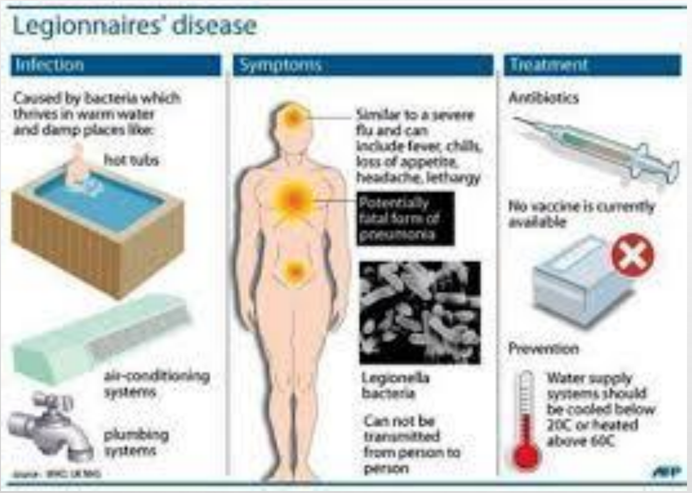
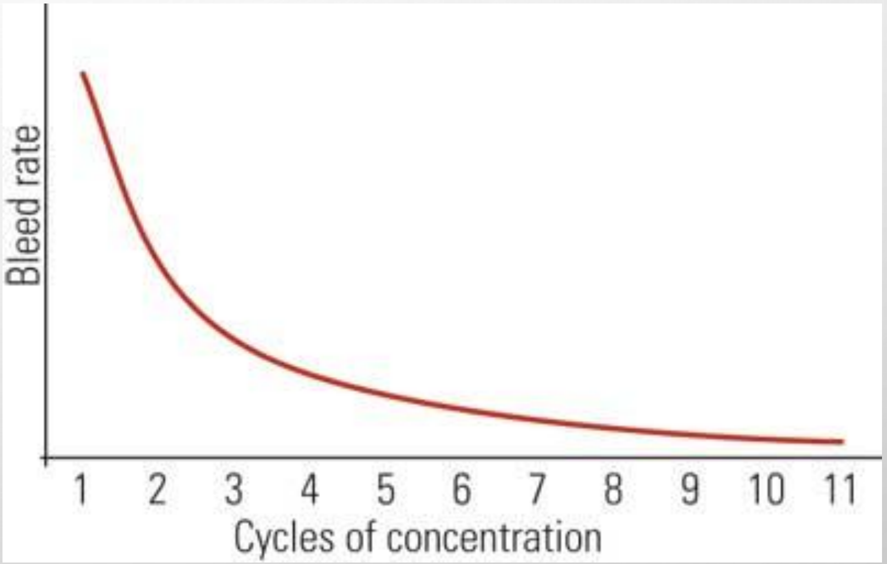
COOLING TOWER WATER TREATMENT GOALS

- PUBLIC HEALTH AND SAFETY



- CONTROL FOULING AND CORROSION

- MINIMIZE WATER USAGE



CYCLES OF CONCENTRATION

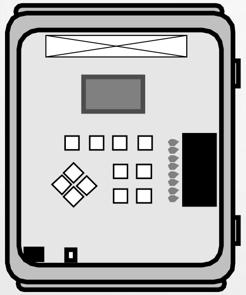
BOILERS AND COOLING TOWERS

- BUILD-UP OF THE CONCENTRATION OF DISSOLVED SOLIDS IN RECIRCULATING WATER = "CYCLING UP"
- DETERMINE THE MAXIMUM NUMBER OF CYCLES OF CONCENTRATION TO RUN W/O FORMING DEPOSITS OR CAUSING EXCESSIVE CORROSION
  - YOUR WATER TREATMENT SUPPLIER IS RESPONSIBLE FOR THIS.

WATER USE AND YOUR RECIRCULATING COOLING WATER SYSTEM

BEFORE: TOWER @ 3 CYCLES

Controller



Setpoint

1,200 uS

= 3 Cycles

30 GPM

Evaporation

3,000 GPM Recirc Rate

Annual Make Up	Annual Bleed
22.86 MG	7.56 MG
$43,094	$19,656

10°F ΔT

45 GPM

Make Up

400 uS

15 GPM

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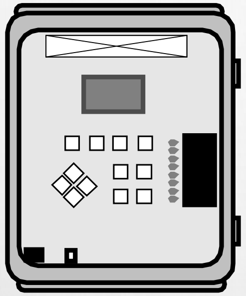
AFTER: TOWER @ 5 CYCLES

Controller



Setpoint

2,000 uS

30 GPM

Evaporation

Annual Make Up	Annual Bleed
19.15 MG	4.03 MG
$36,389	$10,483

= 5 Cycles

10°F ΔT

38 GPM

Make Up

400 uS

3,000 GPM Recirc Rate

8 GPM

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SUMMARY OF COOLING SCENARIOS

	Make Up Flow	Make Up Cost	Bleed Flow	Bleed Cost
3 Cycles	22.86 MG	$43,094	7.56 MG	$19,656
5 Cycles	19.15 MG	$36,389	4.03 MG	$10,483
Savings	3.71 MG	$7,514 (-15.5%)	3.52 MG	$9,173 (-46.7%)

Chemical / Misc Savings = >$10,000 per year

Total Savings = ~$27,000

EFFECTIVE WAYS TO INCREASE CYCLES OF CONCENTRATION

RECIRCULATING COOLING WATER

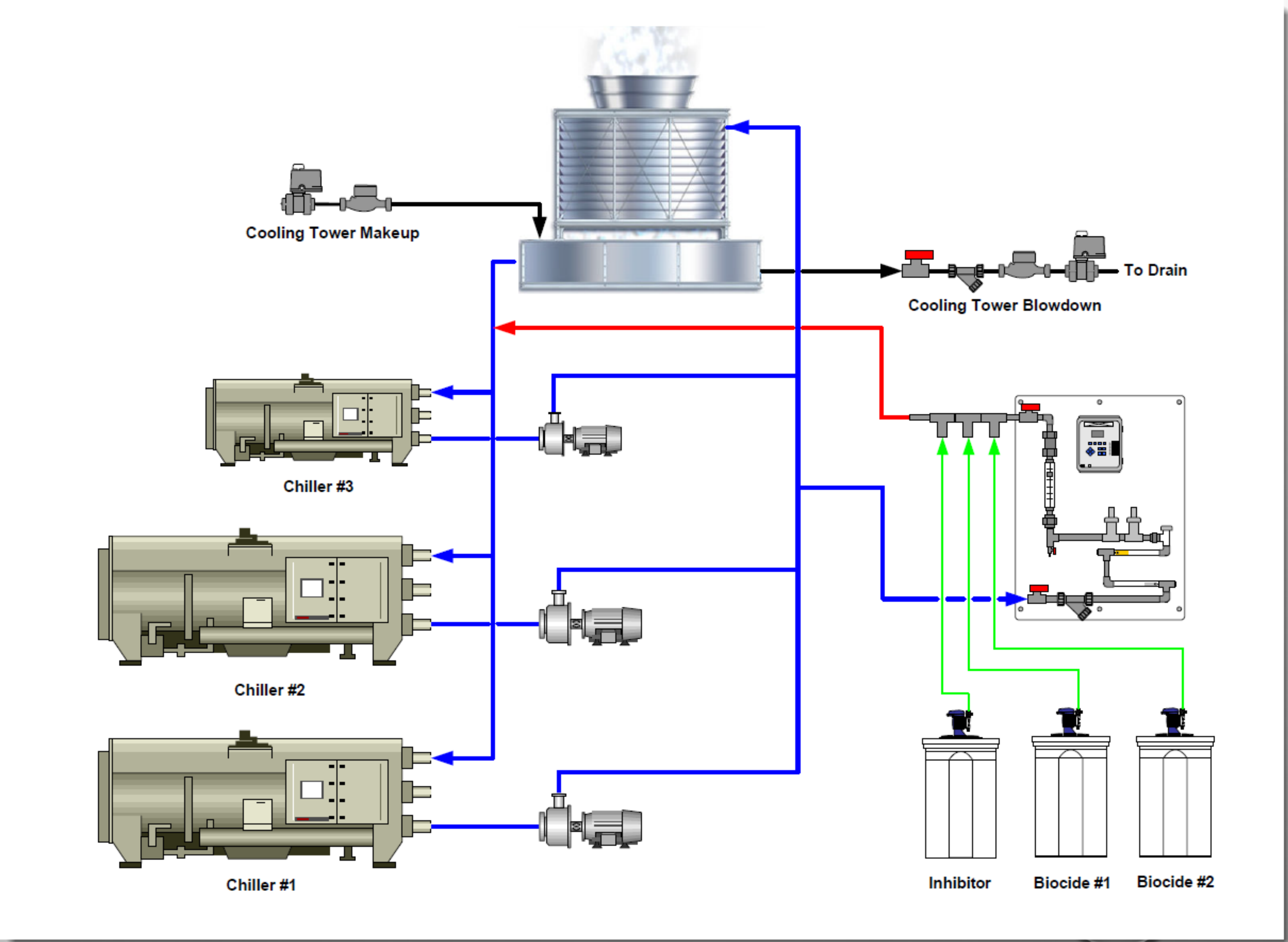
1. Automate chemical feed and tower bleed
2. Soften the makeup water
3. Feed acid to control alkalinity and pH
4. Look for a better source of makeup water
5. Install “side-stream” filtration for solids removal

TYPICAL COOLING SYSTEM LAYOUT

JEFF BODENDORFER

WATERTECH of America, Inc.

COOLING TOWER SYSTEM OVERVIEW

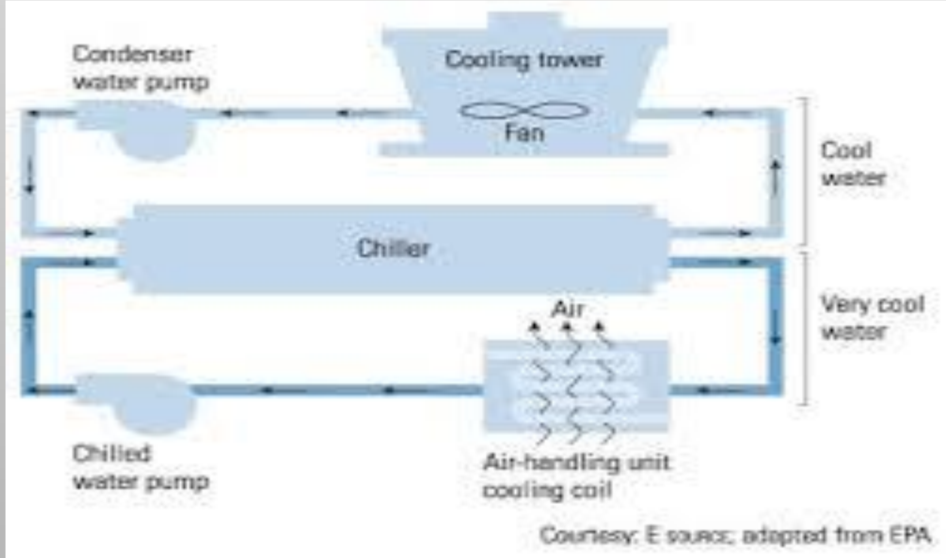


Soft Water or not? Filtration?

- Pros vs. Cons of using soft water for cooling water makeup?
  - Lake Michigan vs. Waukesha water
  - Safety
- What kind of Filtration should you use?

Processes in plants that require cooling water

- What processes do you have that require cooling water?
- Chillers
- Heat exchangers
- How do they work?



Chilled Water Loops

- Concerns with chilled water loops
  - Corrosion
  - Microbiological growth
  - Scale
- What is important to protecting chilled water loops?
  - Scale and corrosion inhibitor
  - Filtration
  - Biocide

Cooling Towers

- What is the purpose of a cooling tower?
  - Reduce water usage/ recycle water
- Types of cooling towers
  - Induced draft
  - Forced Draft

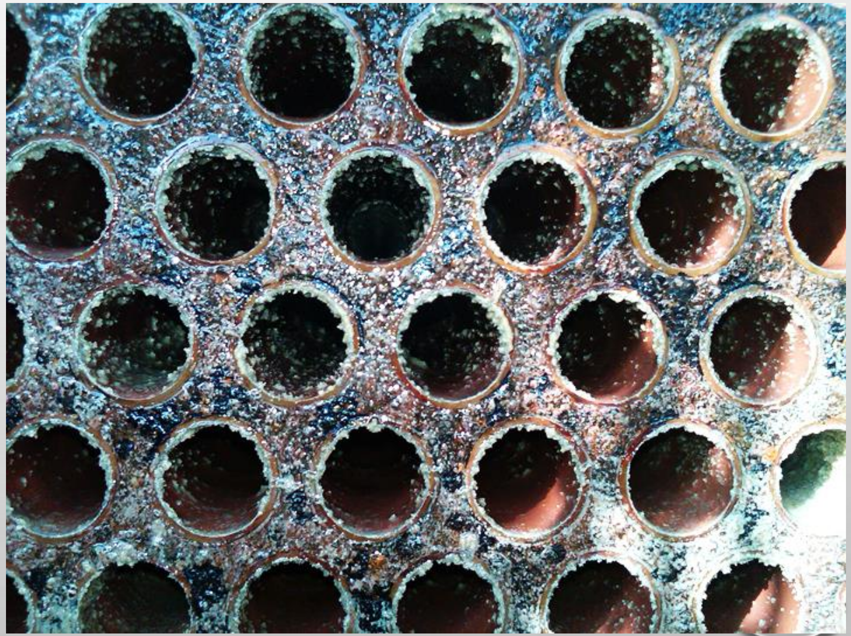
COOLING WATER PROBLEM AREAS

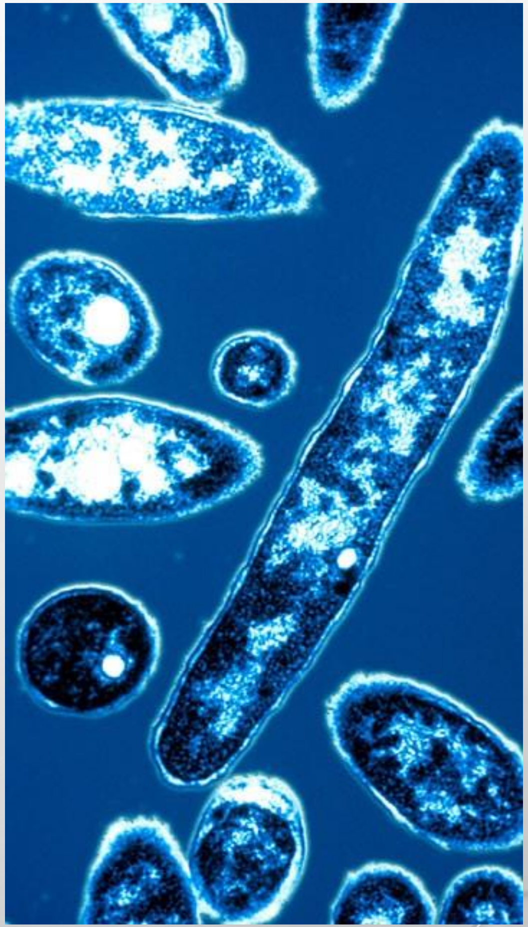
TOM CHRISTMAN

WATERTECH
of America, Inc.

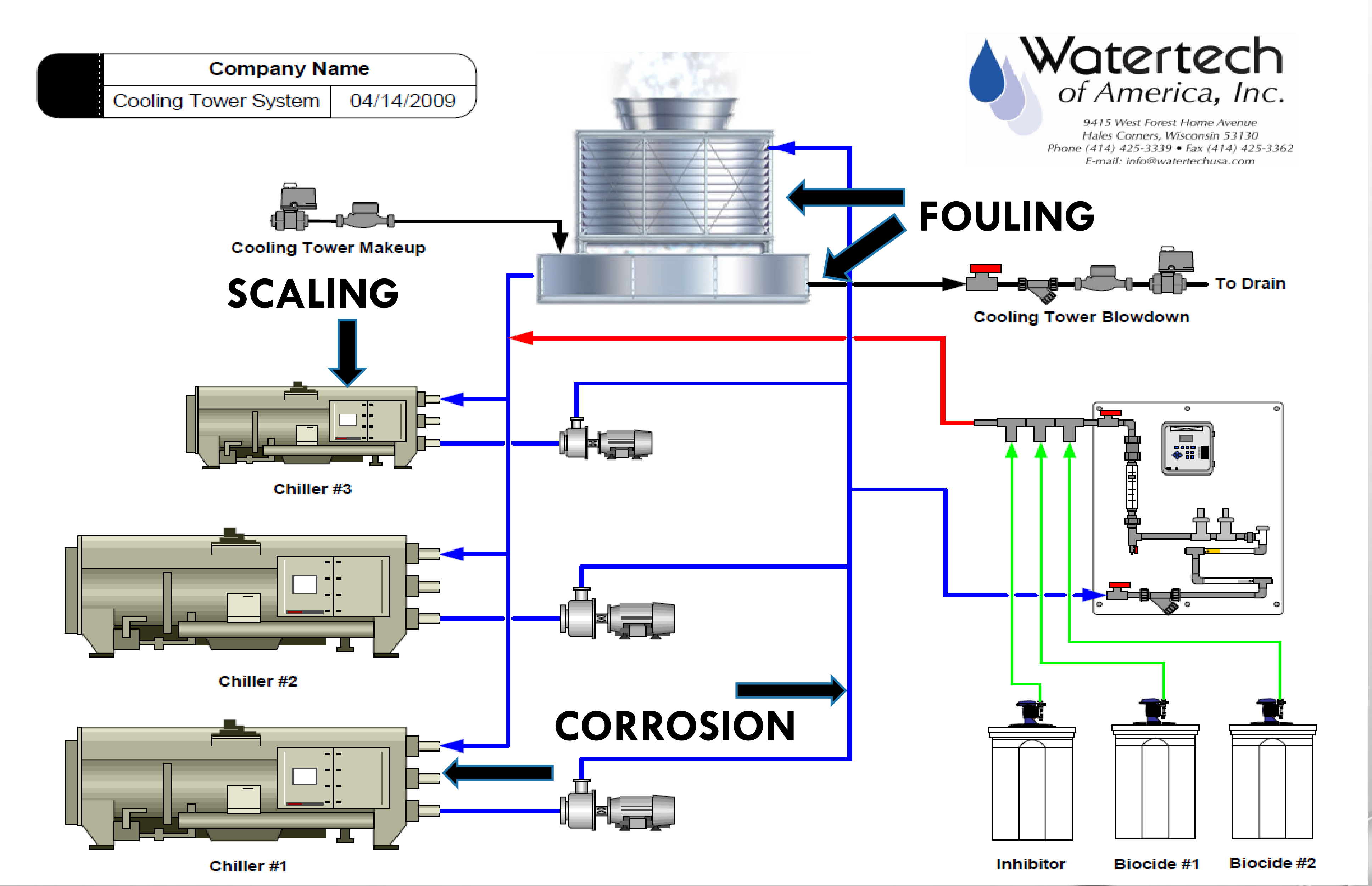
COOLING WATER SYSTEM PROBLEM AREAS

- SCALE – CALCIUM, MAGNESIUM, IRON, SILICA
- CORROSION – LOSS OF METAL
- FOULING
  - MICROBIOLOGICAL – BACTERIA, MOLD, FUNGUS, ALGAE
  - WIND BLOWN DEBRIS, PROCESS CONTAMINATION





COOLING WATER SYSTEM PROBLEM AREAS

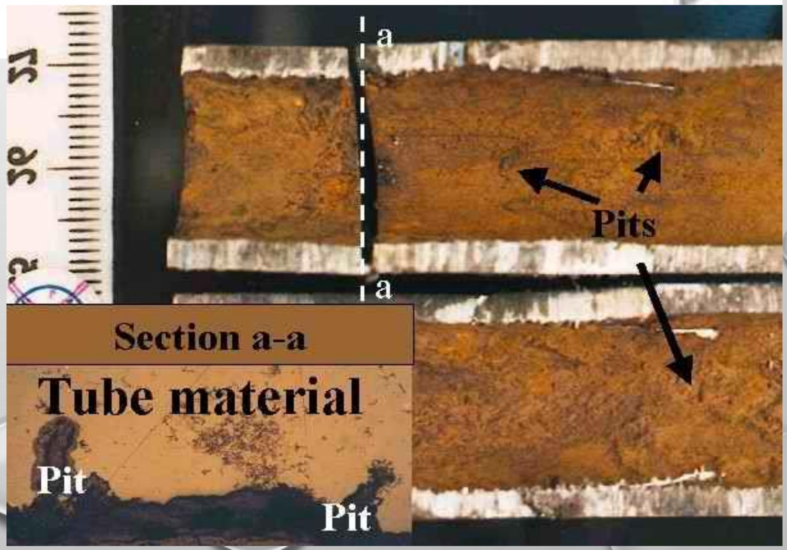


BASIC COOLING WATER TREATMENT PROGRAMS

1. SCALE AND CORROSION INHIBITOR BLEND
2. BIOCIDES
    1. OXIDIZING
    2. NON-OXIDIZING BIOCIDE
3. ANTI-FOULANTS

SCALE AND CORROSION INHIBITOR

- BLEND OF POLYMERS, SEQUESTRANTS, DISPERSANTS AND CORROSION INHIBITORS
  - SPECIFIC BLENDS TO HANDLE VARIOUS WATER QUALITIES AND CONTAMINATION ISSUES
- FEED WITH OR WITHOUT ACID
  - ACID FOR ALKALINITY REDUCTION
- SOFT WATER MAKEUP – CORROSION CONTROL ISSUE
- LAB AND DIRECT MEASUREMENT TESTS FOR MONITORING
  - PTSA, POLYMER, PHOSPHONATE, MOLYBDENUM
- FEED PROPORTIONAL TO MAKEUP/BLEED VOLUME OR DIRECT MEASUREMENT



MICROBIOLOGICAL CONTROL

- BIOCIDES TO CONTROL BACTERIA, MOLD, FUNGUS, ALGAE
  - INHIBIT HEAT TRANSFER
  - INHIBIT FLOW
  - INCREASE CORROSION – "**MIC**" = MICROBIOLOGICALLY INDUCED CORROSION
  - HEALTH AND SAFETY ISSUE – LEGIONELLA

BIOCIDES

OXIDIZING

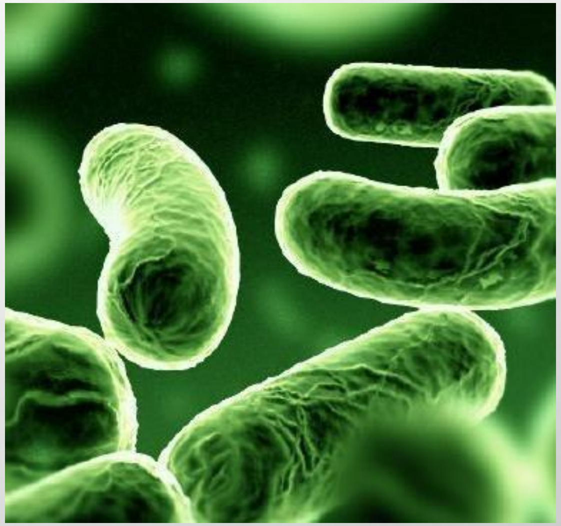
- CHLORINE
- BROMINE
- CHLORINE DIOXIDE
- HYDROGEN PEROXIDE, PERACETIC ACID

NON-OXIDIZING

- ISOTHIAZOLONE
- GLUTERALDEHYDE
- DBNPA
- QUATERNARY AMINE
- MANY MORE

BIOCIDES

1. DOSAGE IS BASED ON SYSTEM VOLUME
2. DIFFERENT BIOCIDES HAVE DIFFERENT REQUIREMENTS
    1. PH, AMMONIA, RETENTION TIME, ORGANICS
3. REQUIREMENTS FOR EFFECTIVENESS
    1. CORRECT CONCENTRATION
    2. SUFFICIENT CONTACT TIME
4. DUAL BIOCIDE PROGRAM WORKS BEST



ANTI-FOULANTS

- DISPERSANTS FOR WIND BLOWN DEBRIS, PROCESS CONTAMINANTS, OIL AND GREASE
- USUALLY SLUG FED
- MAY CAUSE FOAM
- SOME INCREASE THE EFFECTIVENESS OF BIOCIDES BY ACTING AS A WETTING AGENT AND ALLOWING THE BIOCIDES TO PENETRATE THE BIO-MASS.

ANTIFOAMS

- FOR CONTROL OF FOAM CAUSED BY BIOCIDES, ANTIFOULANTS OR PROCESS CONTAMINATION

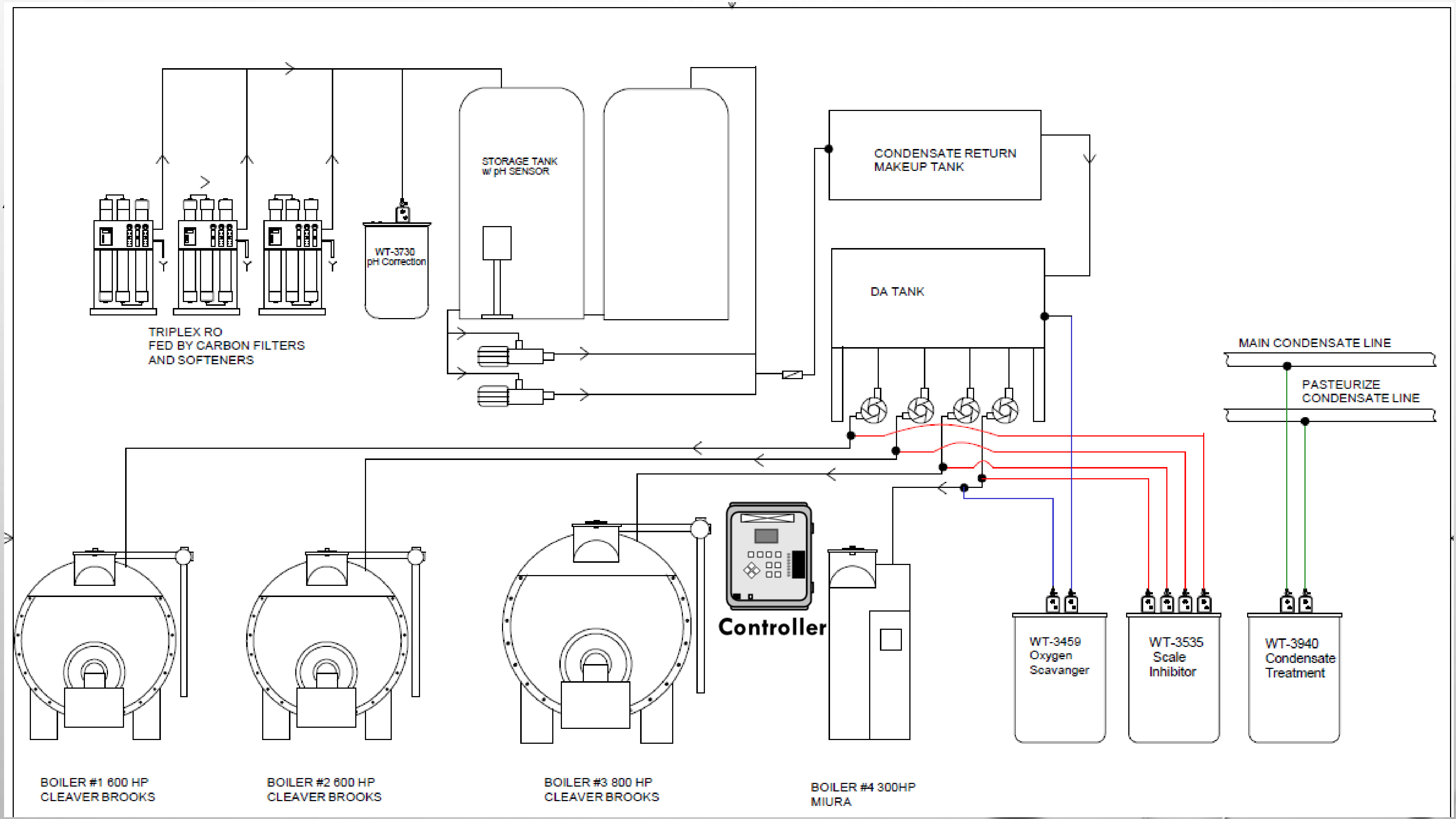
5 KEY TAKEAWAYS TO REDUCE COSTS

1. KNOW YOUR WATER AND BE COMMITTED TO YOUR WATER MANAGEMENT PROGRAM.
2. KNOW YOUR PRETREATMENT EQUIPMENT AND MAKE SURE IT IS OPERATING PROPERLY AND EFFICIENTLY.
3. INSTALL MAKE UP AND BLOWDOWN WATER METERS ON ALL OF YOUR EQUIPMENT WHERE APPLICABLE. KNOW WHERE YOU USE AND DISCHARGE WATER AND HOW MUCH
4. UNDERSTAND CYCLES OF CONCENTRATION TO OPTIMIZE AND REDUCE WATER, ENERGY, CHEMICAL AND SALT USAGE
5. CONSIDER UTILIZING AUTOMATED SYSTEMS TO MONITOR, CONTROL, ALARM AND TREND CRITICAL WATER SYSTEMS.

COOLING TOWER & BOILER WATER EQUIPMENT & CONTROLLERS

JON TIEGS

BOILER SYSTEM OVERVIEW



BOILER SYSTEM – COMMON CONTROLS

- CONDUCTIVITY CONTROL
- CHEMICAL FEED CONTROL

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BOILER CONDUCTIVITY CONTROL

- CONDUCTIVITY INTERMITENT SAMPLE
  - Determine conductivity reading
  - Interval
  - Duration of sample
  - Hold time
- BLOWDOWN CONTROL
  - Open blowdown valve based on conductivity
  - Set point
  - Blowdown time

Relay Control Mode	Intermittent (Fixed Blowdown)
Relay Input Assignment	Boiler Cond(S1)
Current Reading	4554.23 µS
Custom Name	Boiler Blowdown
Relay Status	Off,01:22:23 | Waiting Re-start Sample
Set Point	4500 (0 to 30000)µS
Interval Time	180 (5 to 1440)Min.
Duration of Sample	0 Min. 18 Sec.(10 Sec. to 60 Min)
Hold Time	0 Min. 50 Sec.(30 Sec. to 10 Min)
Blowdown Time	1 (1 to 1440)Min.
Mutual Interlocks	☐ Alarm(R1) ☐ N/A(R2) ☐ N/A(R3) ☐ 3518 COND (R5) ☐ 3459 OX Scav(R6) ☐ 3060M Dispersant(R7) ☐ 3730 ALKALINITY(R8)
Output Mode	○ Hand ○ Off ◉ Auto
Hand Time Limit	1 (1 to 1440)Min.
Event Log	View Log File

BOILER CHEMICAL FEED CONTROL

- FLOW BASED FEED
  - Internal Treatment, Oxygen Scavenger, Alkalinity Builder
  - Assign Meter(s)
  - Volume to Trigger Output
  - Output On Time per Unit Volume

Relay Control Mode	Flow Based Feed
Assign Makeup Meter 1	Make-up Meter(DI_B)
Assign Makeup Meter 2	Not Used
Assign Makeup Meter 3	Not Used
Status	Off
Accumulated Volume	6.00 gal.
Custom Name	3518 COND
Unit Vol. to Trigger Output	18 gal.
Output OnTime Per Unit Volume	0 (Min.) 12 (Sec.)(0 to 1440)Min.
Mutual Interlocks	☐ Alarm(R1) ☐ N/A(R2) ☐ N/A(R3) ☐ Boiler Blowdown(R4) ☐ 3459 OX Scav(R6) ☐ 3060M Dispersant(R7) ☐ 3730 ALKALINITY(R8)
Output Time Limit	30 (0 to 1440)Min.
Output Mode	○ Hand ○ Off ◉ Auto
Hand Time Limit	2 (1 to 1440)Min.
Event Log	View Log File

BOILER SYSTEM – COMMON PROBLEMS

- 90% OF THE PROBLEMS RELATED TO BOILER CONTROLS HAVE TO DO WITH POOR CONDUCTIVITY CONTROL
  - IMPROPER INSTALLATION OF EQUIPMENT
  - INACCURATE CONDUCTIVITY PROBE
  - LEAD/LAG ON SMALL BOILERS

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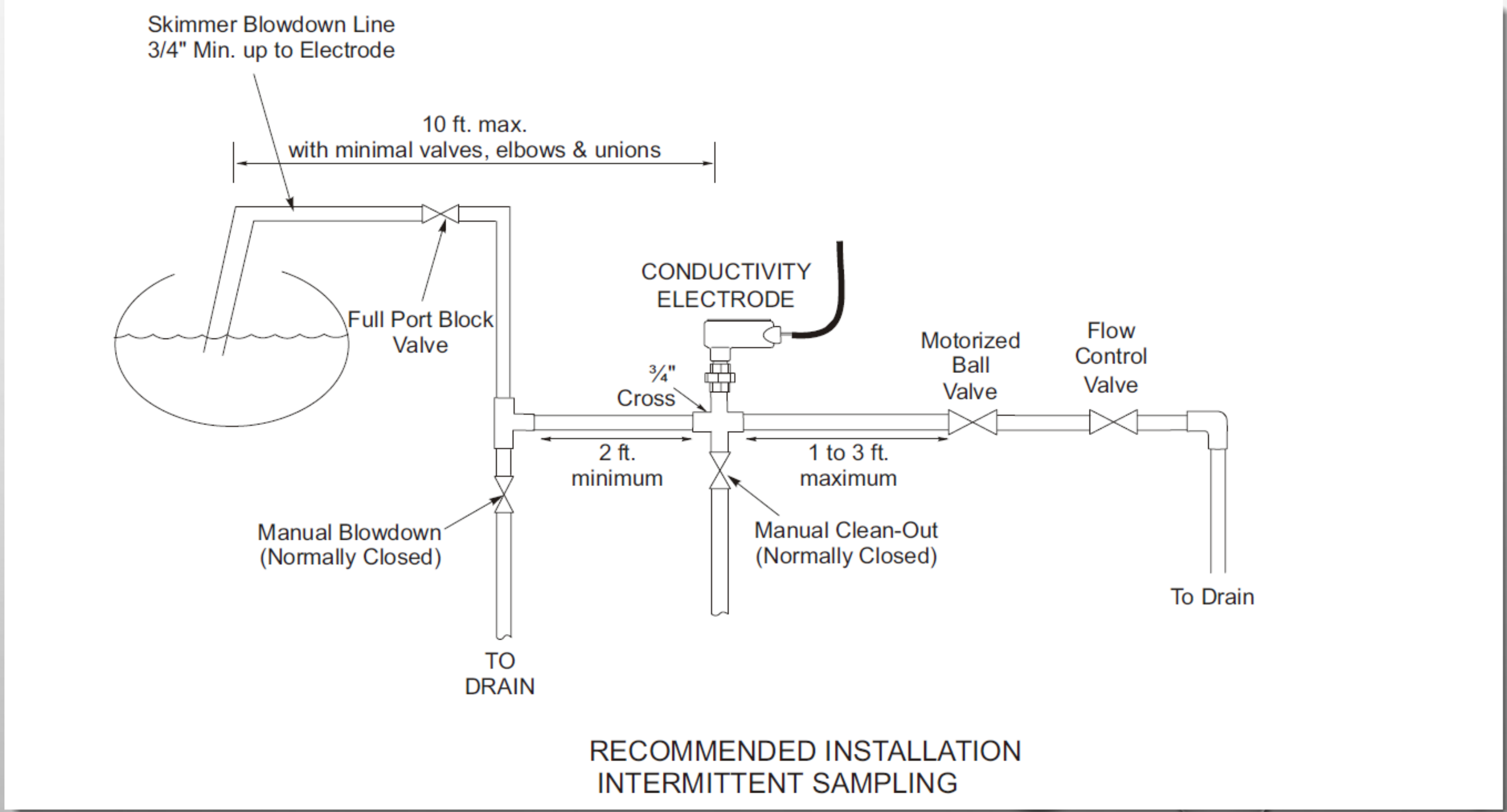
PROPER INSTALLATION OF COMPONENTS IS

THE MOST IMPORTANT

FACTOR FOR EFFECTIVE BOILER CONDUCTIVITY CONTROL

BOILER CONTROL INSTALLATION



BOILER CONTROL INSTALLATION

- WATER LEVEL IN BOILER MUST BE 4-6" ABOVE THE SKIMMER LINE
- MAINTAIN ¾" PIPE FROM THE SKIMMER LINE TO THE CONDUCTIVITY PROBE
- INSTALL A FULL-PORT VALVE UPSTREAM OF PROBE TO PROVIDE MEANS OF REMOVING PROBE FOR CLEANING AND REPLACEMENT
- INSTALL THROTTLING VALVE DOWN STREAM OF PROBE AND AUTOMATIC BLOWDOWN VALVE
- INSTALL PROBE SO THAT OPENING IS IN THE DIRECTION OF FLOW

BOILER CONDUCTIVITY PROBE NOT ACCURATE

- PROBE OUT OF CALIBRATION (CALIBRATE ON A REGULAR SCHEDULE)
- CHECK WIRING FOR LOOSE OR CORRODED WIRES
- CHECK TEMPERATURE READING (CONDUCTIVITY IS TEMPERATURE DEPENDENT)

THE BOILER CONDUCTIVITY CONTROL IS

CRITICALLY IMPORTANT

FACTOR FOR EFFECTIVE BOILER CONDUCTIVITY CONTROL

INVEST IN SPARE PARTS

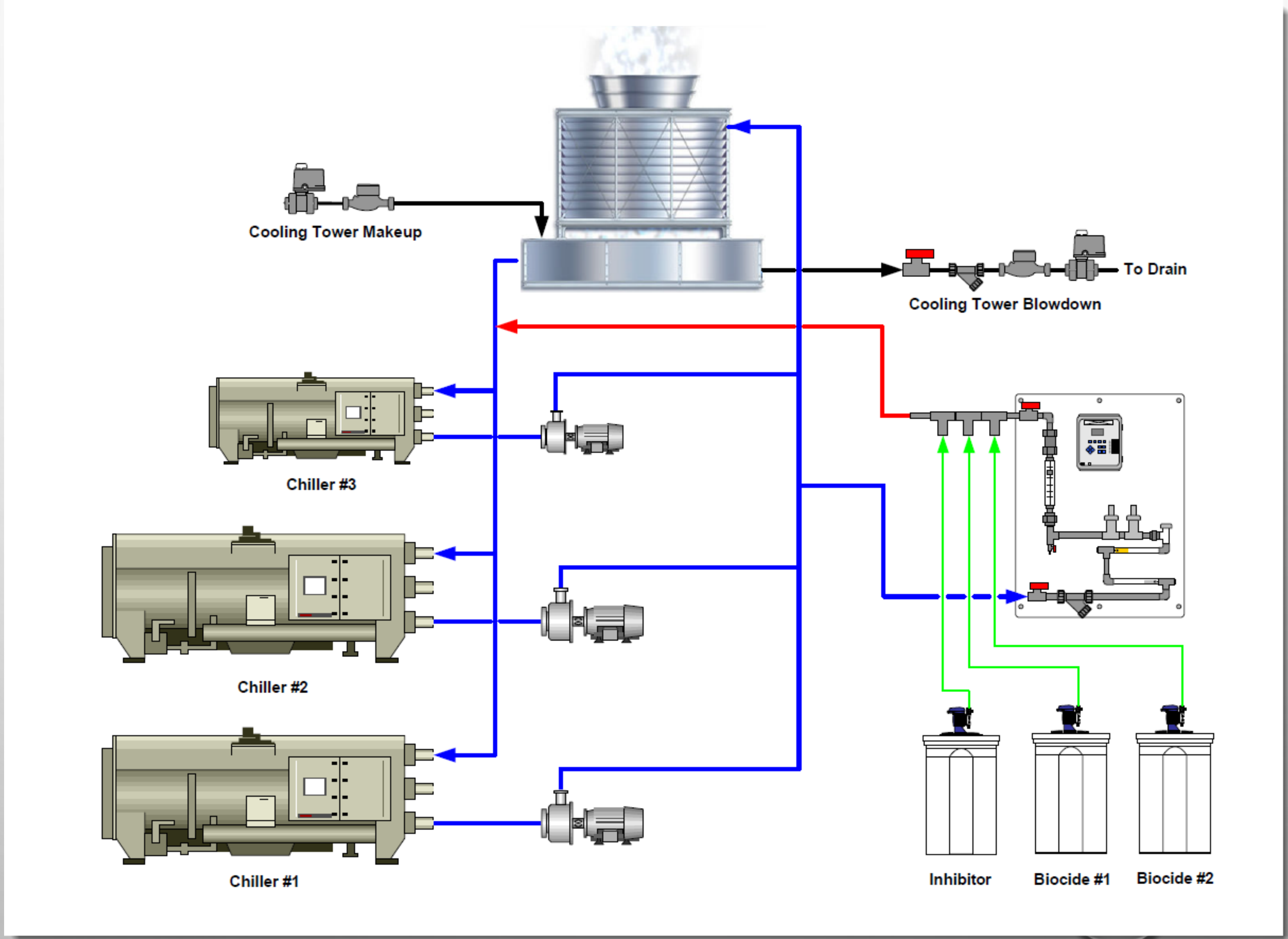
SMALL BOILERS RUNNING IN LEAD/LAG SETUP

SITUATION: BLOWDOWN WHILE IN LAG/STAND-BY REDUCES CONDUCTIVITY

ACTION: PROVIDE A BOILER STATUS INPUT TO THE CONTROLLER

RESULT: LOCKOUT OF BLOWDOWN VALVE WHEN BOILER IS NOT RUNNING WILL PREVENT SAMPLING AND HELP MAINTAIN CONDUCTIVITY.

COOLING TOWER SYSTEM OVERVIEW



COOLING TOWER SYSTEM – COMMON CONTROLS

- CONDUCTIVITY CONTROL
- CHEMICAL FEED CONTROL

WATERTECH of America, Inc.

CONDUCTIVITY CONTROL

- CONTROL SET POINTS
  - Set Point
  - Dead Band
  - Time Period & % of Period
  - Control Direction (Force Lower)
- ACTIONS
  - Bleed opens at Set points
  - Bleed closes at Set Point – Dead Band

Relay Control Mode	On/Off Setpoint
Relay Input Assignment	Twr MMHO(S1)
Current Reading	1265.28 µS
Status	Off
Custom Name	Twr Bleed
Set Point	1300 (0 to 30000)µS
Dead Band	50 µS
Time Period	0 (0 to 1440)Min., 0 to disable
% of Period to Feed	100 (0.1 to 100)%
Control Direction	◉ Force Lower ○ Force Higher
Mutual Interlocks	☐ WT-5765(R2) ☑ WT-5213(R3) ☑ RC416(R4) ☐ WT-5582(R5) ☐ PH Buffer(R6) ☐ Not Used(R7) ☐ Alarm(R8)
Output Time Limit	360 (0 to 1440)Min.
Output Mode	○ Hand ○ Off ◉ Auto
Hand Time Limit	10 (1 to 1440)Min.
Event Log	View Log File

INHIBITOR FEED – FLOW BASED FEED

- SET POINTS
  - Assign Meter(s) to Control
  - Volume to Trigger Output
  - Output On Time per Unit Volume
  - Output Time limit – Max continuous run time (Requires manual reset)
- ACTIONS
  - Relay turns on when Accumulated Volume is achieved.
  - Relay turns off when Output OnTime is achieved.

Relay Control Mode	Flow Based Feed
Assign Makeup Meter 1	Make-up Meter(DI_B)
Assign Makeup Meter 2	Not Used
Assign Makeup Meter 3	Not Used
Status	Off
Accumulated Volume	6.00 gal.
Custom Name	3518 COND
Unit Vol. to Trigger Output	18 gal.
Output OnTime Per Unit Volume	0 (Min.) 12 (Sec.)(0 to 1440)Min.
Mutual Interlocks	Alarm(R1) N/A(R2) N/A(R3) Boiler Blowdown(R4) 3459 OX Scav(R6) 3060M Dispersant(R7) 3730 ALKALINITY(R8)
Output Time Limit	30 (0 to 1440)Min.
Output Mode	Hand Off Auto
Hand Time Limit	2 (1 to 1440)Min.
Event Log	View Log File

INHIBITOR FEED – PTSA (ENVIRODOSE)

- SET POINTS
  - Setpoint
  - Deadband
  - Time period & % of period
- ACTIONS
  - Bleed opens at Set points
  - Bleed closes at Set Point – Dead Band

Relay Control Mode	On/Off Setpoint
Relay Input Assignment	CWT766 Sensor(AI_5)
Current Reading	114.14 ppb CWT766 Sensor(A1)
Status	On,00:00:07
Custom Name	CWT766
Set Point	115 (0 to 748)ppb
Dead Band	2 ppb
Time Period	1 (0 to 1440)Min., 0 to disable
% of Period to Feed	30 (0.1 to 100)%
Control Direction	○ Force Lower ◉ Force Higher
Mutual Interlocks	☐ Acid pump(R1) ☐ Bellacide 355 3/2(R3) ☐ WCA-5213(R4) ☐ Bleed Solenoid(R5) ☐ ORP(R6) ☐ Dispersant(R7) ☐ Alarm(R8)
Output Time Limit	125 (0 to 1440)Min.
Output Mode	○ Hand ○ Off ◉ Auto
Hand Time Limit	10 (1 to 1440)Min.
Event Log	View Log File

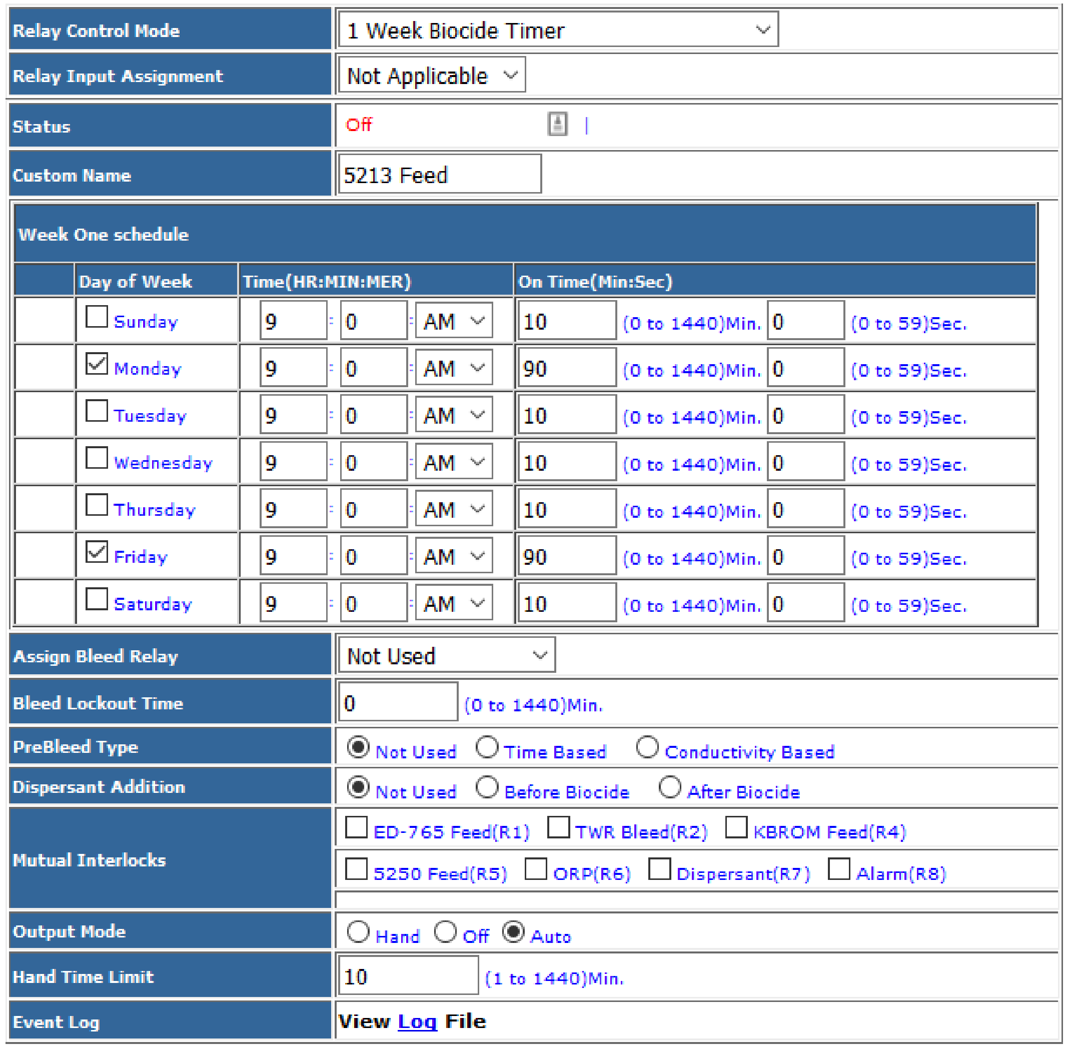
ORP BASED BIOCIDE FEED

- SET POINTS
  - Setpoint
  - Deadband
  - Time period & % of period
- ACTIONS
  - Bleed opens at Set points
  - Bleed closes at Set Point – Dead Band

Relay Control Mode	On/Off Setpoint
Relay Input Assignment	Tower ORP(S3)
Current Reading	614.92 mV
Status	Off,00:02:50
Custom Name	RO Drive Water Va
Set Point	625 (-1400 to 1400)mV
Dead Band	1 mV
Time Period	10 (0 to 1440)Min., 0 to disable
% of Period to Feed	50 (0.1 to 100)%
Control Direction	○ Force Lower ◉ Force Higher
Mutual Interlocks	☐ WT-5753 Pump(R1) ☐ Tower BD Valve(R2) ☐ Sulfuric Acid Pump(R3) ☐ WT-5213 Pump(R4) ☐ K-Brom 40 Pump(R5) ☐ Suppressor 3432 Pump(R6) ☐ WT-3430W Pump(R7)
Output Time Limit	0 (0 to 1440)Min.
Output Mode	○ Hand ○ Off ◉ Auto
Hand Time Limit	30 (1 to 1440)Min.
Event Log	View Log File

TIME BASED ORP FEED

- SET POINTS
  - Select Days, Times & Feed Time Period
  - Bleed Lockout
  - Prebleed (Time or Conductivity)
  - Mutual Interlocks (Lockouts)
- ACTIONS
  - At selected day & time relay feed event occurs.
  - If using Prebleed then Bleed Valve relay will open.
  - Once Prebleed is complete then Chemical Pump relay will turn on for specified time.



Relay Control Mode	1 Week Biocide Timer
Relay Input Assignment	Not Applicable
Status	Off
Custom Name	5213 Feed

Week One schedule

	Day of Week	Time(HR:MIN:MER)			On Time(Min:Sec)			
	☐ Sunday	9	0	AM	10	(0 to 1440)Min.	0	(0 to 59)Sec.
	☑ Monday	9	0	AM	90	(0 to 1440)Min.	0	(0 to 59)Sec.
	☐ Tuesday	9	0	AM	10	(0 to 1440)Min.	0	(0 to 59)Sec.
	☐ Wednesday	9	0	AM	10	(0 to 1440)Min.	0	(0 to 59)Sec.
	☐ Thursday	9	0	AM	10	(0 to 1440)Min.	0	(0 to 59)Sec.
	☑ Friday	9	0	AM	90	(0 to 1440)Min.	0	(0 to 59)Sec.
	☐ Saturday	9	0	AM	10	(0 to 1440)Min.	0	(0 to 59)Sec.

Assign Bleed Relay	Not Used
Bleed Lockout Time	0 (0 to 1440)Min.
PreBleed Type	◉ Not Used ○ Time Based ○ Conductivity Based
Dispersant Addition	◉ Not Used ○ Before Biocide ○ After Biocide
Mutual Interlocks	☐ ED-765 Feed(R1) ☐ TWR Bleed(R2) ☐ KBROM Feed(R4) ☐ 5250 Feed(R5) ☐ ORP(R6) ☐ Dispersant(R7) ☐ Alarm(R8)
Output Mode	○ Hand ○ Off ◉ Auto
Hand Time Limit	10 (1 to 1440)Min.
Event Log	View Log File

COOLING TOWER SYSTEM – COMMON PROBLEMS

- CONDUCTIVITY PROBLEMS
- CHEMICAL FEED PROBLEMS

POOR CONDUCTIVITY CONTROL

- PROBE OUT OF CALIBRATION
- DIRTY PROBE OR CORRODED PROBE
- CHECK WIRING
- INADEQUATE FLOW
- NO BLEED FLOW
  - INOPERABLE BLEED VALVE OR CLOGGED BLEED LINE

CHEMICAL FEED PUMPS NOT PUMPING

- LOSS OF PRIME
  - EMPTY TANK
  - OFF GASSING / AIR LOCKED
  - CRACKED SUCTION TUBE
- CLOGGED INJECTION VALVE